MCRP 3-37C
FM 3-11

Flame, Riot Control Agents and Herbicide Operations

U.S. Marine Corps

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Preface

This publication describes the doctrine, tactics, and techniques for employing flame weapons, riot control agents (RCA), and herbicides during peacetime and combat. It is intended primarily for use by chemical personnel at all echelons in planning the employment of flame and non-lethal materials (RCAs and herbicides). Training with RCAs is discussed in detail in TC 3-8, *Chemical Training*.

This manual does not implement any international standardization agreements; however, the material within the manual is in accordance with related international agreements.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

Extracts from FM 5-250, *Explosives and Demolitions*, are used extensively throughout this field manual for technical and operational clarity. For further information concerning the use of military explosives and their components, see FM 5-250.

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CHAPTER 1

U.S. Policy for Flame, Riot Control Agents and Herbicides

Policy govering US policy for RCA and herbicides is found in Executive Order 11850 dated 8 Apr 75, Renunciation of Certain Uses in War of Chemicals, Herbicides, and Riot Control Agents.

WARTIME USE

The US has renounced first use of herbicides in war except under regulations applicable to domestic use or for control of vegetation within US bases and installations and around their immediate perimeters.

The US has renounced the first use of RCAs in war. US forces will only use RCAs in war in defensive modes to save lives as approved by the President.

In wartime, use of RCAs outside the war zone is authorized as prescribed for peacetime.

For RCA and herbicide use, war is any period of armed conflict no matter how it may be characterized, including declared and undeclared war, counterinsurgency, and any other uses of armed forces in engagements between US military forces and foreign military or paramilitary forces. Armed conflict is conflict between states in which at least one party has resorted to the use of armed force to achieve its aims. It also may involve conflict between a state and uniformed or non-uniformed groups within that state, such as organized resistance groups.

Commanders must recognize that, while the US does not consider herbicides and riot control agents to be chemical weapons, some other countries do not draw a distinction. Commanders must consider international ramifications and Rules of Engagement before recommending the use of herbicides or RCAs.

PEACETIME USE

The Secretary of the Army, as Executive Agent for the Department of Defense for civil disturbance operations, has issued instructions governing the use of RCAs in civil disturbances in the US, the Commonwealth of Puerto Rico, and US possessions and territories.

RCAs may be used on US bases, posts, embassy grounds, and installations for protection and security purposes, riot control, installation security, and evacuation of US noncombatants and foreign nationals. The US-controlled portions of foreign installations are considered US installations.

Chemical aerosol-irritant projectors may be used by military law enforcement personnel for the performance of law enforcement activities. They may be used--

- On-base and off-base in the United States and its territories and possessions.
- On-base overseas and off-base overseas in those countries where such use is specifically authorized by the host-country government.

RCAs may be used off-base (worldwide) for the protection or recovery of nuclear weapons under the same conditions as those authorized for the use of lethal force. (See DOD Directive 5210.56.)

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RCAs may be used in training. A review of current treaties and/or Status-of-Forces Agreements between the host country and US forces may be required in determining whether or not training with RCAs is authorized overseas.

Herbicides may be used within US bases, posts, and installations for control of vegetation. Use of herbicides off-base overseas must be in accordance with host country laws and agreements, US Environmental Protection Agency (EPA) requirements, or Service regulations, whichever are the most stringent.

AUTHORITY

Only the *President* may authorize the following:

- Use of RCAs in war, including defensive military modes. However, advance authority to use RCAs for protection or recovery of nuclear weapons has been delegated to the Secretary of the Defense.
- Wartime use of herbicides, including installation vegetation control.

The *Secretary of Defense* may authorize the following:

- Use of RCAs or herbicides in peacetime.
- Use of RCAs in wartime for the protection or recovery of nuclear weapons.

CINCs and the Chiefs of Services may authorize:

- The use of RCAs in peacetime on US installations for riot control, installation security, civil disturbance operations, and non-combatant emergency evacuation operations. The US-controlled portions of foreign installations are considered US installations.
- The movement and storage of RCAs and herbicides, as necessary, to support requirements, provided US control is maintained.
- The off-base use of RCAs in peacetime for the protection or recovery of nuclear weapons under the same situations as authorized for the use of lethal force.
- The use of herbicides in peacetime within and, when authorized by the host country government, around US bases for control of vegetation.
- The use of chemical aerosol-irritant projectors by military law enforcement personnel during peacetime for the performance of law enforcement activities in the following areas:
    - On-base and off-base in the US and its territories and possessions.
    - On-base and off-base overseas in those countries where such use is specifically authorized by the host country government.
- Authority for use of RCAs in peacetime situations not covered by the above (for example, to save lives in counterterrorist operations) will be addressed in plans and requested by the combatant commanders for Secretary of Defense approval.

WEAPONS EMPLOYING FIRE

The use of weapons that employ fire, such as tracer ammunition, flamethrowers, napalm, and other incendiary agents, against targets requiring their use is not a violation of international law. They should not, however, be employed to cause unnecessary suffering to individuals.

CHAPTER 2

Flame Operations

FLAME EFFECTS

Flame is a valuable close combat weapon that burns, depletes oxygen, and impacts psychologically. Since man fears flame, it is used to demoralize troops and reduce positions that have resisted other forms of attack. Flame produces the following effects:

Casualties. Casualties result from--

- Burns. Thickened fuel sticks to clothing and skin, burns with intense heat, and is extremely difficult to extinguish.
- Inhalation of flame, hot gases, and carbon monoxide.
- Suffocation.
- Shock.

Psychological. The psychological impact is probably one of the greatest effects of flame. In many cases, defending personnel will leave well-prepared positions and risk exposure to other weapons or capture. In other cases, the enemy is forced to withdraw from firing positions during the effective period of the flame attack. This permits friendly forces to close in before the enemy reoccupies his firing positions.

Splatter. Flame reaches around corners through the splattering and ricochet action of the thickened fuel on adjacent surfaces. The splattering action of the thickened fuel spreads the flame over an area--in contrast to the point effects of nonfragmenting small arms ammunition.

Incendiary. Flame ignites combustible materials to cause additional problems for personnel. Flame weapons ignite clothing, tentage, wires, petroleum products, buildings of light construction, light vegetation, munitions, and other combustible material.

Battlefield Illumination and Signaling. Controlled, slower burning flame field expedients (FFEs) can be used for close-in battlefield illumination and signaling. These devices can be made to vary in illumination time from a few minutes to hours.

Smoke. The burning fuel from flame weapons and FFEs produces a dense black smoke that can reduce battlefield visibility appreciably. Smoke from ignited materials can prolong this condition. This black smoke may attract the enemy's attention to the flame attack and invite counterfire. To minimize any hindrance to friendly operations, the

presence of this smoke must be anticipated when planning operations in which flame weapons or FFEs will be used.

FLAME WEAPONS

The flame weapons available are the M202A1 rocket launcher, incendiary grenades, and FFEs.

M202A1
Rocket Launcher

The M202A1 Rocket Launcher (Figure 2-1) is a lightweight, individual rocket launcher aimed and fired on the right shoulder from the standing, kneeling, or prone position. The launcher is loaded with a clip (M74) which contains four rockets. It can fire one to four rockets semiautomatically at a rate of one rocket per second and can be reloaded with a new clip.

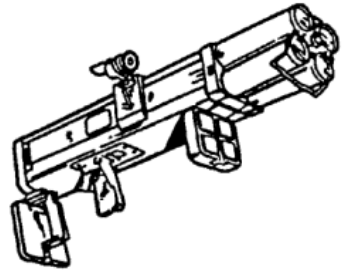

Figure 2-1. M202A1 flash, 66mm rocket launcher.

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The M74 rocket (Figure 2-2) is filled with thickened pyrophoric agent (TPA). This TPA is triethylaluminum (TEA), a substance similar to white phosphorus, which bums spontaneously when exposed to air (exposure occurs on impact, therefore, no fuel is wasted by burning en route to target). It burns at temperatures between 1400-2200 degrees Fahrenheit. The M74 is used to engage area-type targets out to a range of 750 meters and point-type targets out to a range of 200 meters. The minimum safe firing distance to a target is 20 meters (M74 has a bursting radius of 20 meters; therefore, engaging targets closer than 20 meters may result in injury to friendly troops).

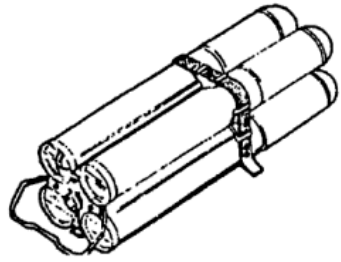

Figure 2-2. M74 rocket clips.

Incendiary Grenades

The AN-M14 TH3 incendiary hand grenade is filled with thermite, which bums at 4,000 degrees Fahrenheit. The grenade bums for 40 seconds and can bum through a 1/2-inch homogeneous steel plate. It can damage, immobilize, or destroy vehicles, weapon systems, shelters, or munitions. The grenade may also be used to start fires in areas containing combustible materials.

Flame Field Expedients

FFEs can generate violent, effective combat power at decisive times and places on the battlefield. These systems--fougasses, flame mines and flame trenches--can be used by tactical commanders to aid in--

- Repelling enemy penetrations.
- Destroying enemy forces.
- Gaining time.
- Providing obstacles.
- Isolating or canalizing an enemy.
- Slowing enemy movement.

- Surprising enemy forces.
- Degrading enemy morale.
- Deceiving enemy forces.

FFEs are formidable, uncomplicated weapons that lend themselves to support of both light and heavy forces at all levels of the spectrum of conflict. When applied at decisive times and places on the battlefield, flame weapons reinforce fighting positions, achieve surprise, and produce casualties and psychological shock. They may also provide battlefield illumination during limited visibility to help see enemy forces trying to assault friendly forces. Exploding FFE devices produce casualties from the immediate development of extremely high levels of heat at the moment of detonation. Additionally, exploding FFEs produce hundreds of white-hot shards of metal as the container breaks apart. However, the most dangerous part of an FFE is the burning thickened fuel that either is spread in all directions or projected over a large area. Thickened fuel is a syrupy liquid that sticks to a target and continues to burn. Once ignited, flame fuel is extremely difficult to extinguish.

Selected FFE devices are constructed to simply burn in place and provide light during limited visibility. Illuminating devices burn for an unspecified time. Generally, these flare-like systems will burn from four to eight hours depending upon the quantity of fuel contained. They are designed to provide battlefield illumination for the destruction of enemy forces trying to assault friendly fighting positions.

FLAME ATTACK TARGETS

In selecting flame attack targets, consider the type of flame weapon available.

Fortifications

Flame is particularly effective in the attack of personnel in shelters such as fortifications. Its effectiveness depends on as the size, number, and type of apertures and construction of the fortification. A small fortification may be entirely reduced, but a fortification with more than one internal compartment fortification with more than one internal compartment usually affords comparative safety to its occupants. The flame fuel must actually penetrate a fortification for maximum results. More fuel is required to cause casualties among personnel in well-ventilated fortifications than in poorly ventilated ones of the same size. Casualties in fortifications may result from suffocation (because oxygen from the air is consumed by the flame) or from actual burns.

Other Targets

Personnel in open fighting positions are vulnerable to flame. Thickened and pyrophoric fuel tends to stick to the clothing and skin of the occupants and the area, forcing the occupants to abandon the position or stay and be burned by the flaming fuel and risk becoming casualties.

Occupants of built-up areas can be forced to abandon their positions or become casualties, either from contact with the burning fuel or from fires caused by ignition of combustible materials (such as wooden buildings).

Personnel concealed in vegetation can be forced to abandon their positions or become casualties.

If the burning fuel penetrates the occupied compartment of the vehicles, personnel in armored vehicles may become casualties unless they abandon the vehicles. Armored vehicles buttoned up and moving are not good targets for flame. The burning fuel must penetrate the openings of the vehicles to be effective. Burning fuel will not ignite the tracks of moving armored vehicles. Incendiary devices attached to or penetrating the openings of armored vehicles can be effective in disabling the vehicles.

Personnel in unarmored vehicles will become casualties or be forced to abandon the vehicles if flaming fuel is placed in them, since any combustible material in or a part of the vehicles may be ignited or damaged.

Weapon positions may become untenable if hit with burning fuel or incendiary material. Occupants may become casualties and weapons and ammunition may be damaged.

Wires and cables covered with combustible material may be damaged by ignition of the coverings from burning flame fuel or fires from flame or incendiary devices.

Small arms ammunition may be destroyed by use of flame fuels and/or incendiary devices.

Generally, supplies that are combustible may be destroyed or damaged by flame fuels. Noncombustible supplies can be damaged or destroyed by incendiary devices or by secondary fires from combustible materials; for example, supplies stored in a wooden building would be damaged by fires that destroyed the building.

WEATHER EFFECTS ON FLAME FUELS AND WEAPONS

Wind has minimal effect on the M202A1's range and accuracy.

Rain has little effect on flame fuel in flight. Flame fuel will float and burn on water. The incendiary effect is less on damp material than on dry material.

Snow has little effect on flame fuel in flight. However, snow tends to smother flame, reducing its incendiary effects in the target area.

High temperatures tend to increase the fuel's incendiary action. Flame fuels in high temperatures may have to be thickened so that they do not burn excessively in flight to the target. Low temperatures decrease the incendiary action and more fuel may be required to ignite combustible materials. Additionally at low temperatures, flame fuel

may have to be made less thick to ensure ignition. Specific precautions and procedures must be followed in fuel selection, preparation, storage, and firing.

DESTRUCTION TO PREVENT ENEMY USE

Materiel subject to capture or abandonment in a combat zone (except medical) is destroyed by the using unit only when, in the judgement of the military commander concerned, destruction is necessary to keep the materiel from falling into enemy hands.

Emergency destruction procedures for fuel, ingredients, and flame weapons are given below. Detailed methods of equipment destruction are presented in appropriate technical manuals and bulletins pertaining to specific items of equipment.

Flammable fuels or lubricants may be destroyed by burning or pouring on the ground.

Thickeners may be destroyed by opening the containers and either dumping the contents into water or tire or spreading the contents on the ground. M202A1 rocket launchers and M74 rocket clips should be destroyed by burning, demolition, gunfire, or disposal.

FLAME EMPLOYMENT PRINCIPLES

Flame weapons are employed for both anti-personnel and anti-materiel effects. This principal use in offensive operations reduces fortifications, suppresses fire, and produces casualties or exposes enemy personnel to the fire of other weapons. In defensive operations they complement other weapons in fire plans. They can be used to destroy buildings and equipment, clear tunnels, destroy food, clear light vegetation, counter ambushes, illuminate defensive areas, warn of enemy approach, and restrict enemy use of trails and paths.

Tactics

Flame assumes great importance in ground warfare against an enemy whose tactics place emphasis on mass in the attack and stubborn, unyielding resistance in the defense. Even in relatively fluid, rapidly changing situations, an enemy may be able to establish excellent defensive fortifications, requiring increased use of flame for destruction.

The M202A1 and incendiary grenades are used primarily in offensive operations while FFEs are used primarily in the defense. The M202A1 can be used in both offensive and defensive roles because of its light weight, great range, and minimal service requirement. The decision to use M202A1, grenades, or FFEs is based on their comparative effectiveness for the particular mission.

In planning the attack, the commander considers the use of flame as a part of his fire support plan. Defensively, flame weapons may be used in the coordinated plan for fires and in support of the counterattack. Flame can often be used to blunt and disrupt mass enemy attacks, but the disadvantages of flame in both defensive and offensive operations

must be considered. Careful planning and coordination are needed for maximum benefit from the use of flame in the attack or defense.

OFFENSIVE FLAME USE

Flame has many qualifications as an offensive assault weapon. It demoralizes, produces casualties, and ignites combustible material; and it has good searching capability through its splattering action. When combined with infantry, tanks, and supporting fires, flame contributes greatly to the accomplishment of the mission. It is particularly effective when combined with infantry fires during the last stages of the assault. Flame weapons can be decisive against an enemy lacking any tank or fire support other than automatic weapons.

Plans should be as simple and direct as possible. Apply the following basic principles of employment in planning for the use of flame weapons in the attack.

As with other weapons, a proper reconnaissance is a must for successful employment of flame weapons. The target and any element supporting it must be located; a route of approach that offers protection from enemy fire must be selected; and the amount of flame required and the need for demolition and breaching support must be determined. The M202A1 can be employed without a thorough reconnaissance if the rear danger zone and the minimum safe range restrictions are observed.

Use sufficient flame. The number of flame weapons used depends on a number of factor--the size and nature of the objective, the terrain, and the enemies' morale and physical condition, for example. Piecemeal use of the M202A1 should be avoided. The enemy should be made to feel that unless he surrenders or withdraws immediately he will be burned to death. Within control capabilities for coordination of flame weapons supporting the maneuver force, the more flame that can be placed on suitable targets, the greater the probability of success during the attack. The attack should be pressed boldly. Supporting fires must lift or shift as necessary to allow flame weapons to close with the enemy. These fires should continue on enemy supporting positions.

Follow up with infantry. The enemy seldom fights at his best when he is caught in a flame attack. He usually does one of three things: surrenders, runs, or hides under cover. If he runs before the arrival of the flame, he may return to his position when the attack is over, even though the flame fuel is still burning on the ground. Enemy positions in the flame attack area may hold their fire until the flame attack is over. It is essential, therefore, that infantry supported by a flame attack follow it closely and quickly before the enemy can regain his position or reorganize his defenses. Friendly infantry must and can enter the area while flame is still burning on the ground. Troops must be given training in following a flame attack closely and in dashing through flame on the ground. Surprise and shock must be exploited to the fullest extent. Success in any tactical operation depends largely on the timing and coordination between the flame teams and the unit with which they are operating.

Rehearse. Time should be made available for rehearsals for flame attack. Rehearsals should be conducted on ground similar to the terrain to be traversed and against a point resembling the objective. If the attack is to be made at night, rehearsals should be conducted at night.

DEFENSIVE FLAME USE

The use of flame weapons can be a major factor in the successful defense of any position. Flame weapons are particularly effective in disrupting the final stages of an enemy assault. The short range of flame weapons, however, restricts their employment and requires that they be carefully located to obtain the best advantage. The longer range of the rocket launcher increases that weapon's flexibility.

The following flame weapons/munitions can be used in the defense: M202A1 and FFEs. These weapons are integrated into defensive fire plans to supplement or reinforce other fires. Defensive flame fire plans may employ flame weapons uniformly within unit areas, massed at likely avenues of approach against anticipated massed enemy assaults, or may deploy them in reserve blocking positions ready for use in the counterattack. Particular attention is given to the resupply or replacement of empty flame weapons to ensure sustained support for the defense.

Flame weapons are most effective when integrated into the plan for fire support and the obstacle plan. They are used to supplement or reinforce other defensive fires or to defend a small sector not covered by other weapons.

The basic considerations of defense apply to the use of flame:

Proper use of terrain. Flame teams are located on key terrain on the perimeter of the platoon defense areas. FFEs may be emplaced in the gaps between platoons, in approaches to the position, or on key terrain forward of the battle position that the defending force does not plan to hold, and in blocking positions in depth.

Defense in depth. FFEs are placed in likely areas of penetration. The use of these expedients is coordinated with counterattacking forces.

Mutual support. FFEs should be integrated into final protective fires and should be emplaced to provide mutually supporting area coverage. A technique is to use FFEs to fill gaps between indirect fire targets and force or canalize enemy troops into final protective fires.

All-round defense. FFEs may be positioned to protect the flanks and rear of the position.

The fire plan. FFEs can be used to supplement the long-range and close defensive fires of mortars and artillery. However, coordination is required to prevent duplication of effort and destruction of the FFEs by friendly fires. FFEs can also be used in internal defense

operations to counter ambush, clear underbrush, illuminate defensive areas, serve as warning devices, and inflict casualties on the attacking troops.

Reinforcement of obstacles. Natural and artificial obstacles can be reinforced or extended by flame weapons. For example, flame fuel floats and burns on water and can be used on shallow streams to prevent assaulting foot troops from crossing. FFEs can be used as floating flame devices. FFEs must be used carefully to avoid damaging mines or destroying camouflage.

Antitank measures. Armored vehicles can often move safely through flame fuel burning on the ground if the area is traversed quickly and the flames are not high enough to be sucked in through vents. However, flame fired directly on a tank can neutralize it by obscuring the driver's vision, seeping inside through vents, or setting the tank afire. The minimum effect is profound fear and decreased efficiency of the tank crew. FFEs may be located on probable tank approaches.

Brush and forest fires. Flame weapons must be used carefully to avoid starting brush and forest fires that may hinder the defense. When it is desirable to start fires deliberately, consider the following factors:

- Probable effect on enemy operations.
- Danger to friendly troops and installations.
- Effect on friendly observations.
- Effect on future friendly operations.
- Effect on environment.
- Effect on noncombatants.

CHAPTER 3

Flame Fuels

The three types of flame fuels are unthickened, thickened, and triethylaluminum (TEA). Unthickened fuel is a thin, pourable, highly flammable liquid composed of gasoline and oil. Thickened fuel is a thick, jellylike substance ranging in consistency from a pourable liquid to a rubbery, very thick gel. TEA is a thickened pyrophoric substance similar to white phosphorus. It burns spontaneously at temperatures of 1,400 to 2,200 degrees Fahrenheit when exposed to air.

Use unthickened fuel in situations where range is not an important factor or when fuel is needed on short notice. Unthickened fuel has advantages: you can prepare it quickly and it is readily available; however, it has a short range of about 20 meters and is quickly consumed. Another disadvantage is that unthickened fuel offers little penetration of fortifications or fighting positions. It does not rebound effectively from surfaces.

Thickened fuel requires equipment, time, and personnel for mixing, aging, and transferring. Unless you store it in airtight steel containers, thickened fuel has an uncertain period of stability. However, thickened fuel burns longer than unthickened fuel and clings to a target. It splashes across surfaces and, therefore, is effective when employed during military operations on urbanized terrain (MOUT). Since you will use thickened fuel more extensively than unthickened fuel in flame field expedients, this chapter will primarily address thickened fuel.

Both thickened and unthickened fuels are used to kill, dislodge, and demoralize personnel, to neutralize fortifications, and to destroy flammable material. Burning unthickened/thickened fuel is very effective against personnel caught in the open.

THICKENED FLAME FUELS

Thickened fuel consists of a thickener and gasoline. The Army uses two different thickeners, M4 and M1.

M4 thickener is a fine white powder that is a by-product of petroleum processing. Even though M4 thickener is hydroscopic (absorbs water from the air), you may reseal a partially used container and store it for one day. M4 thickener comes in 2.5-pound cans or 100-pound drums.

M1 thickener is a coarse, light tan, granular material that is extremely hydroscopic. The presence of moisture in it decreases its ability to form a stable flame fuel. You should discard a partially used container of M1 thickener.

Thickened Fuel

Flame field expedients use number 3 flame fuel. The consistency of the fuel is based on a factor of 3 in determining the amount of thickener to add to a specific amount of gasoline. When mixing a batch of flame fuel, use the applicable equation for either M4 or M1 thickener.

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Thickened Flame Fuels

Storage

For M4 thickener, the equation is gallons of gasoline x fuel number = ounces of thickener required. For example, to mix 50 gallons of thickened flame fuel, calculate the amount of thickener needed as follows: 50 (gallons) x 3 (flame fuel) = 150 ounces of M4 thickener.

For M1 thickener, the equation is gallons of gasoline x fuel number x 2 = ounces of thickener required. For example, to mix 50 gallons of thickened flame fuel, calculate the amount of thickener needed as follows: 50 (gallons) x 3 (flame fuel) x 2 = 300 ounces of M1 thickener.

NOTE:

Although this publication addresses M1 thickener, it is not currently maintained in the active Army inventory. However, limited stocks exist in certain Reserve and National Guard units and some Allied armies.

Mixing Site

Mixing sites must be--

- Free of fire hazards.
- Located on firm, well-drained terrain.
- Convenient to supply delivery points for gasoline and thickener.
- Centrally located for fuel delivery to using units.
- Well-ventilated and outside of any enclosures such as buildings or tents.
- Posted with NO SMOKING WITHIN 50 FEET signs.

In addition, an appropriate (at least a 10-pound carbon dioxide) fire extinguisher should be at the site.

WARNING

Allow no smoking within 50 feet of gasoline or fuel. You must strictly enforce this rule. Post NO SMOKING signs in prominent places around an area where fuel is being mixed, handled, or stored. If NO SMOKING signs are not available, post guards.

Do not permit open flames, heated stoves, or other sources of heat that might cause ignition of gasoline fumes in the immediate vicinity of mixing and filling operations or where fuel is stored and handled.

Personnel

Use personnel experienced in mixing flame fuels. Thoroughly train inexperienced personnel before allowing them to mix flame fuel.

Containers

All containers used for mixing or storing flame fuels must be clean and ungalvanized. Zinc from a galvanized container will cause the fuel to break down.

Mixing

You can mix flame fuels either by hand or with an air source using the "bubbling" procedure.

Hand Mixing

Use hand mixing for small quantities of flame fuel. This method requires the following equipment:

- Clean, ungalvanized container or containers of gasoline.
- Bucket and funnel if transferring into smaller containers for use in flame expedient devices.
- One 10-pound carbon dioxide fire extinguisher.
- M4 thickener.
- Mixing paddle (wooden).

Use the following four steps for mixing by hand:

Step 1. Open container of gasoline.

Step 2. Open container of thickener and breakup lumps by hand. Add thickener to gasoline evenly over a 5 to 9 minute time span. Do not dump it into the fuel. Stir gasoline continuously while adding the thickener.

Step 3. Continue to stir mixture until fuel has the appearance of applesauce.

Step 4. Check fuel periodically during mixing to ensure that thickener has become evenly suspended within the gasoline. If the thickener begins to settle to the bottom, mix more slowly.

NOTE

At low temperatures (below 32°F for M4 thickener and 70°F for M1 thickener), longer mixing time is required with larger amounts of thickener. You may need as much as two hours for mixing in very cold conditions.

Mechanical Mixing

Mechanical mixing (also called "bubbling") uses mechanical equipment to prepare flame fuel. This equipment must be grounded before use to safeguard against static electricity. For details on grounding procedures, refer to technical manuals for the equipment to be used.

WARNING

Do not operate electrical apparatuses or other equipment likely to cause sparks within 25 feet of the mixing equipment.

The mechanical mixing method requires the following equipment:

- M4 compressor or vehicle with an air source.
- Two 25-foot air hoses.
- One 10-pound carbon dioxide fire extinguisher.
- Container or containers of gasoline.
- M4 thickener.

Use the following 11 steps for mechanical mixing:

Step 1. Position the M4 air compressor or vehicle with an air source 25 feet upwind from mixing area.

Step 2. Ground the M4 compressor and chock rear wheels of the vehicle.

Step 3. Connect both air hoses.

Step 4. Connect air hoses to the air source.

Step 5. Open the container of gasoline.

Step 6. Open the containers of thickener --*one at a time, as needed.* Breakup any lumps by hand.

Step 7. Start the M4 air compressor or vehicle. Turn on the air pressure to 4 to 5 psi.

Step 8. Insert the air hose into the container of gasoline until hose tip is at the bottom of the container.

Step 9. When the bubbling action begins, slowly pour the required amount of thickener into the gasoline container.

WARNING

Do not insert the air hose into gasoline container before activating the air supply; doing so will cause gasoline to enter the air hose and, on activation of the air supply, gasoline will splash out of the container. Wearing goggles will prevent splashing in eyes.

Step 10. Continue the bubbling process until fuel has the appearance of applesauce.

Step 11. Check the fuel periodically during mixing to ensure the thickener has become evenly suspended within the gasoline. If the thickener begins to settle to the bottom, mix more slowly.

Aging

Flame fuel allowed to age will have complete gelling of the gasoline and thickener. To age fuel, store it in sealed containers; leave a 5-percent void for expansion. You may use newly mixed fuel immediately after mixing, if necessary; however, aged fuel will bum more uniformly than newly mixed fuel.

Whenever possible, allow thickened flame fuel to age at the same temperature at which it was mixed. Fuel aged at extremely high or low temperatures has a tendency to break down after a short time.

At moderate temperatures, fuel prepared with M4 thickener requires 6 to 8 hours to age completely. Fuel prepared with Ml thickener requires 8 to 12 hours to age completely. The aging time increases as temperatures decrease.

Testing

Consistencies of thickened flame fuel may vary greatly even if mixed under identical conditions. This variation is due to different mixing techniques, slight differences in thickeners and gasoline from different manufacturers, the moisture content within the gasoline, and gasoline temperature.

Experienced personnel can estimate the characteristics of flame fuel by observing the fuel and handling it with a wooden mixing paddle. No definite rules exist for visual tests. Experience will help determine the characteristics of the gel to its probable flame

characteristics. In general, thickened fuels burn longer but have limited spread; thin fuels have greater spread but burn more quickly.

Fuel that is too thick will stand like gelatin. This is caused by too much thickener, too much stirring, or a gasoline temperature above 85 degrees F. Fuel that is too thin will flow like gasoline with a few lumps in it. This is caused by not enough thickener, too little stirring, or gasoline temperature below 32 degrees F. Once the fuel is fully mixed, you cannot change its consistency by adding fuel or thickener.

WARNING

Mix flame fuel only with a wooden paddle or stick. Do not put hands into the fuel to test consistency. Fuel on hands or clothing creates a fire hazard. Also, repeated skin exposure to gasoline may be harmful. Wooden paddles or other wooden items used to stir or test thickened flame fuels are potential fire hazards, Dispose of these as flammable waste or store them properly.

Water Detection

Moisture in either gasoline or thickener is very detrimental to the quality of the thickened flame fuel. Moisture will cause the fuel to break down rapidly.

You can easily detect water in gasoline by sampling the liquid at the bottom of the container. An alternate method is to stir the contents of the drum briskly, sample the gasoline (with a clear container) while it is still agitated, and let the sample settle. If water is present, it will be visible at the bottom of the clear container.

Water Removal

You may use any of several methods to remove water from gasoline before mixing thickened flame fuel. These methods include siphoning, decanting, and filtering.

WARNING

Containers of gasoline can be heavy and awkward to handle. You will need more than one individual to complete the water removal process, Gasoline can spill and cause a fire hazard or gasoline burns.

Siphoning

Tilt the drum containing-gasoline and let it stand in the tilt position for several minutes. Water in gasoline container will collect in the lowest portion and can be siphoned off.

Decanting

Let the gasoline container stand undisturbed for 10 to 15 minutes. Then very carefully pour the gasoline in one continuous motion, leaving any water that has settled to the bottom of the container.

Filtering

Filtering is a simple field expedient method for removing water from small amounts of gasoline. To filter, pour the gasoline through a shelter half spread loosely over a dry, open 55-gallon drum and bound securely to the drum (Figure 3-1). Gasoline will pass through the shelter half but water will not. You can filter fifty gallons of gasoline in 10 minutes at an average rate of 5 gallons per minute, which slows as the filtering continues.

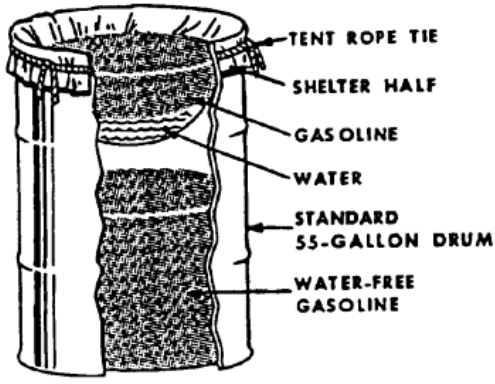

Figure 3-1. Example of a field expedient gasoline filter

Remove any water or silt remaining in the hollow of the shelter half before you filter more gasoline. Shelter halves used for this purpose are no longer serviceable; dispose of them after use.

Fuel Quality

Many factors interact when you mix thickened flame fuel. These factors are variable and may change the quality of the fuel.

Temperature

Gasoline temperature has a pronounced effect on the gelling of thickened flame fuel. For best results, gasoline temperature should be between 32 degrees F and 85 degrees F. At

gasoline temperatures below 32 degrees F (70 degrees F when M1 thickener is used), mixing time becomes prohibitive.

Thickener

The ratio of thickener and gasoline directly influences the properties of thickened flame fuel. A higher thickener content causes a greater consistency of the gel. Increasing the amount of thickener produces the following effects:

- Decreased mixing time.
- A more stable fuel in storage.
- Decreased amount of fuel burned in flight to a target.
- Increased burning time on target.

Improper Mixing

Strict adherence to the mixing procedures is required when you prepare flame fuel by hand. Insufficient stirring will cause unevenly suspended thickener in the gasoline. Two layers of fuel with different consistencies will result. Too much stirring may cause the applesauce-like gel to break down. This, in turn, will cause premature deterioration of aged fuel.

STORAGE

Gasoline is usually stored either in 5-gallon military gasoline cans or 55-gallon steel drums. Store thickeners as shipped.

Store flame fuel in clean, dry, ungalvanized containers. The most commonly used containers are 55-gallon drums of 14-gage or heavier steel with two bungs, but you may use 16- or 18-gage steel drums. Do not use drums more than five years old to store thickened flame fuel. Containers used to store thickened flame fuel must never be reused to store or handle automotive fuel. The residue of thickened fuel will lower the quality of the automotive fuel.

Locations

The storage location for thickened flame fuel or its ingredients should be as dry as possible and well camouflaged. Consider gasoline and thickened flame fuel as a field storage group and store them together, but never store them with any other field storage groups.

Procedures

You must take every precaution to ensure that water does not enter gasoline or thickened flame fuel containers during storage. Keep drums in storage tightly closed to prevent loss through evaporation and to prevent entry of moisture. To store, place drums of gasoline

and thickened flame fuel on their sides; when stored this way, water will not collect around the bungs and the rubber gaskets will remain soft.

Place containers of gasoline and thickened flame fuel on concrete blocks or skids. Inspect containers (cans or drums) weekly to ascertain that they are tightly closed and that no leakage has occurred.

Thickener alone is not flammable. However, it is classified as an ammunition item and must be stored in an ammunition supply point (ASP). Separate different lots of thickener in storage. Inspect stored containers periodically for corrosion.

Stability of Fuel in Storage

In general, the higher the consistency of thickened flame fuel the greater the storage stability. After it has been stored, you should check thickened flame fuel for deterioration before you use it. Deteriorated fuel will have large lumps of fuel surrounded by a watery fluid. Storage stability of thickened flame fuel is influenced by--

- Consistency.
- Quality of thickener.
- Quality of gasoline.
- Moisture content of gasoline and thickener.

CHAPTER 4

Exploding Flame Devices

Historically, exploding flame devices have been employed with great success in combat. In the Korean Conflict, the 8th Cavalry Regiment, 1st Cavalry Division, inflicted casualties on the Chinese Communists with strategically placed exploding flame devices. During combined operations in the Republic of Vietnam, the 10lst Airborne Division and the 2d Republic of Korea Marine Brigade made extensive use of FFEs to the south of Da Nang to clear vegetation and rid several areas of booby traps.

GENERAL INFORMATION

Exploding flame devices cause casualties by inflicting injuries from burning fuel and flying debris. These devices also have a great psychological effect that may deter or slow an enemy attack. All exploding flame devices consist of a container, incendiary fuel, and a firing system (burster and igniter) to scatter and ignite the fuel. The size of the area covered depends on the size of the container and the firing system used.

Components

Field expedient flame weapons generally consist of four basic components--a container, fuel, an igniter, and a burster. Appendix B contains detailed information on the proper use of demolition accessories.

Container

Anything that will hold the fuel, such as a standard issue military canteen or even a 55-gallon drum, can serve as a container.

Fuel

Fuel is a combustible liquid that produces an immediate fire, such as thickened or unthickened MOGAS.

Igniter

An igniter is an incendiary used to set the exploding fuel alight. M49 trip flares, incendiary grenades, M34 white phosphorus (WP) grenades (combat use only), or even small containers of raw gasoline may be used. An expedient method for employing raw gasoline as an igniter is to fill a used meals, ready-to-eat (MRE), bag with gasoline and

seal it with tape. This will produce enough immediate fire to ensure ignition of an FFE device.

Burster

A burster is an explosive charge that scatters the fuel. Examples of bursting charges include, but are not limited to, trinitrotoluene (TNT), composition C4, M4 field incendiary bursters, detonating cord, and M18A1 Claymore mines. See Appendix B for further information about demolition materials.

NOTE

Expedient battlefield illuminators do not detonate; there is no need for a burster when employing this type of FFE. Battlefield illuminators are discussed in Chapter 5.

CONTENTS

General Information

Electrically Initiated Devices

Bunker Bombs

Render Safe

Removal, dismantling, or otherwise rendering safe an exploding flame field expedient device that has been emplaced consists of removing the blasting cap, the igniter, and the FFE device.

WARNING

Only those personnel trained in safe handling of explosives and their components are authorized to perform render safe procedures.

Hasty Emplacement

For hasty or overnight defensive operations (in the absence of metal or plastic containers), dig holes in the ground and fill with premixed thickened fuel. Attach an exploding igniter (M34 WP grenade in combat only) to the device by detonating cord. Area coverage will vary, depending on size and shape of the hole, amount of thickened fuel, and the explosive charge used.

ELECTRICALLY INITIATED DEVICES

Controlled devices are fired using an electrical firing system. See Appendix A for details concerning the construction of electrical firing systems and proper testing procedures respectively.

5-Gallon Device

To construct the 5-gallon device (Figure 4-1), use these five-step procedures:

Step 1. Fill this device with thickened flame fuel. It can be rapidly emplaced either on the surface or in a V-trench.

Step 2. Prime (hasty whip) one M4 burster with 10 to 12 turns of detonating cord, leaving a 10-foot pigtail for a main line.

Step 3. Place the M4 burster inside the container.

Step 4. Attach two electric blasting caps (that have been tested) to a firing wire using a common series circuit.

Step 5. Attach both electric blasting caps to the main line by making a loop in the detonating cord and attaching the blasting caps to it. The device is ready to be fired.

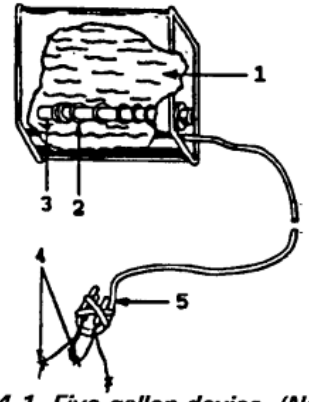

Figure 4-1. Five-gallon device. (Numbers correspond to steps in text.)

NOTE:

Non-electric blasting caps can also be used. See Appendix A for further information on the nonelectrical firing system.

Area coverage is approximately 20 to 30 meters in diameter. Use this small yet deadly device with anti-personnel mines to complement established mine fields. Although it is small, you may use this device against enemy targets such as wheeled vehicles, personnel in the open, and suspected enemy parachute drop zones.

Each 5-gallon flame device requires the following:

- 5-gallon container.
- Five gallons of gasoline.
- 25 feet of detonating cord.
- Two electric blasting caps.
- M4 field incendiary burster.
- 15 ounces of M4 thickening compound.

55-Gallon Device

The three devices described in the following paragraphs are basically defensive weapons designed for perimeter protection during static defense. You may employ these devices singly or in clusters for increased coverage. Additionally, you may emplace 55-gallon land mines (flame) in the center of road intersections to slow or stall the movement of an enemy convoy. Other uses for FFE include, but are not limited to, large-area coverage of suspected enemy aircraft landing zones for rotary wing aircraft and parachute drop zones.

Vertical Flame Mine with M4 Burster

Use the following nine steps to construct a vertical flame mine with M4 bursters (Figure 4-2):

Step 1. Fill device with thickened flame fuel and place in an upright position.

Step 2. Prime the drum with detonating cord (10 to 12 turns) around the base, leaving a 3-foot pigtail for attachment to the ring main.

Step 3. Prime two M4 bursters (three in combat) with 10 to 12 turns of detonating cord, leaving a 4-foot pigtail for attachment to the ring main.

Step 4. Place the M4 bursters inside the large bung of the drum.

Step 5. Place a ring main of detonating cord around the device, leaving 40 feet of detonating cord to be used as a main line.

Step 6. Attach both bursters and detonating cord around the base to the ring main by girth hitches with an extra turn.

Step 7. Place seven or eight sandbags on top of the drum to force the explosion down and outward in a 360-degree radius, keeping the entire detonation low to the ground.

Step 8. Attach two electrical blasting caps (that have been tested) to a firing wire, using a common series circuit.

Step 9. Attach both electric blasting caps to the main line by making a loop in the detonating cord and attaching the blasting caps to it. The device is ready to be fired.

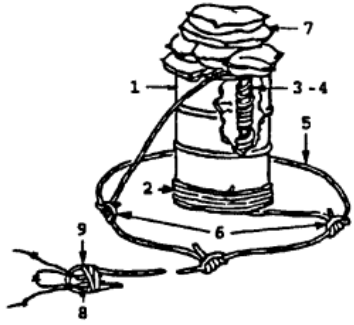

Figure 4-2. Example of a vertical flame mine with M4 bursters. (Numbers correspond to steps in text.)

Area coverage is approximately 80 to 100 meters in diameter. During combat, you will obtain maximum fragmentation by placing engineer screw pickets upright against the device. The pickets are then held in place by tightly wrapping barbed wire around the device.

Each 55-gallon flame land mine requires the following:

- 55-gallon container.
- Fifty gallons of gasoline.
- 100 feet of detonating cord.
- Two electric blasting caps.
- Two or three M4 field incendiary bursters.
- 150 ounces of M4 thickening compound.
- Seven or eight sandbags.

Vertical Flame Mine with Detonating Cord

To construct a vertical flame mine with detonating cord (Figure 4-3), follow the procedures described in steps 1 through 9.

Step 1. Fill device with thickened fuel and place in an upright position.

Step 2. Using a 6-foot length of detonating cord, tape one end over the spoon handle of an igniter (M49 trip flare or (in combat) M34 WP grenade).

Step 3. Prime the drum with detonating cord (seven to ten turns) around the base of the device leaving 40 feet to be used as a main line.

Step 4. Place a wooden stake near the device and attach igniter to it.

Step 5. Attach the igniter detonating cord to main line by use of a girth hitch with an extra turn.

Step 6. Place six or seven sandbags on top of the drum to force the explosion down and outward in all directions, keeping the entire detonation low to the ground.

Step 7. Remove the safety pin from igniter.

Step 8. Attach two electrical blasting caps (that have been tested) to a firing wire using a common series circuit.

Step 9. Attach both electric blasting caps to main line by making a loop in the detonating cord and attaching electric blasting caps to it. The device is ready to be fired.

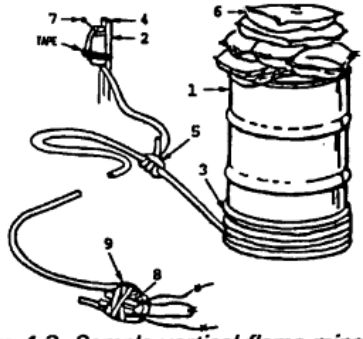

Figure 4-3. Sample vertical flame mine with detonating cord. (Numbers correspond to steps in text.)

Area coverage is approximately 50 to 80 meters in diameter. Each 55-gallon flame land mine requires the following:

- 55-gallon container.
- 50 gallons of gasoline.
- 200 feet of detonating cord.
- Two electric blasting caps.

- 150 ounces of M4 thickening compound.
- M49 trip flare or (in combat) M34 WP grenade.
- Six or seven sandbags.

Horizontal Flame Mine

To construct a horizontal flame mine (Figure 4-4), use the following procedures (11 steps):

Step 1. Fill the device with thickened flame fuel and place it on its side.

Step 2. Separately prime two 1.25-pound blocks of composition C4 or two l-pound blocks of TNT with seven to ten turns of detonating cord, leaving two 3-foot pigtails on each block of explosive for attachment to the ring main.

Step 3. Attach the blocks of explosives to each end of the drum. Two sandbags work well--one under and one against the device.

Step 4. Place a ring main around the device.

Step 5. Attach the pigtails from the blocks of explosives to the ring main by using girth hitches with an extra turn.

Step 6. Using a 6-foot length of detonating cord, tape one end over the spoon handle of an igniter (M49 trip flare or (in combat) M34 WP grenade.

Step 7. Place a wooden stake near the device and attach igniter to it.

Step 8. Attach the detonating cord from the igniter to the ring main by using a girth hitch with an extra turn.

Step 9. Remove the safety pin from the igniter.

Step 10. Attach two electrical blasting caps (that have been tested) to a firing wire using a common series circuit.

Step 11. Attach both electric blasting caps to the main line by making a loop in the detonating cord and attaching blasting caps to it. The device is ready to be fired.

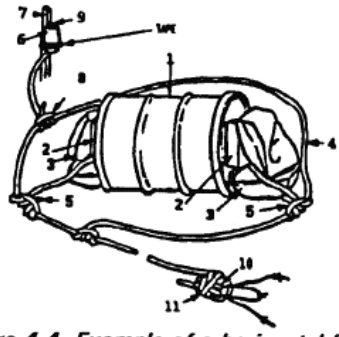

Figure 4-4. Example of a horizontal flame mine. (Numbers correspond to steps in text.)

Area coverage is approximately 80 to 100 meters laterally. Each horizontal 55-gallon flame land mine requires the following:

- 55-gallon container.
- 50 gallons of gasoline.
- 100 feet of detonating cord.
- Two electric blasting caps.
- 150 ounces of M4 thickening compound.
- M49 trip flare or (in combat) M34 WP grenade.
- Two 1.25-pound blocks of composition C4 or two 1-pound blocks of TNT.

Flame Fougasse Devices

The flame fougasse is a variation of an exploding FFE in which the flame is projected by explosive means over a preselected area. An excellent defensive weapon, the fougasse can also provide illumination as well as produce casualties. On Defensive Line Wyoming, during the Korean Conflict, elements of the 1st Cavalry Division emplaced 1,000 drums of FFEs in front of fighting positions. The drums were set in the ground at a 45-degree angle with the opening toward the enemy. Two examples of flame fougasses are the propellant charge container and the 55-gallon container.

Propellant Charge Container

To construct the propellant charge fougasse (Figure 4-5), use these procedures (20 steps):

Step 1. Using a metal cylinder or propellant charge container, knock a small hole into the bottom.

Step 2. Fabricate a pusher plate (wood or metal) the same size as inside diameter of the container.

Step 3. Thread the detonation cord through the small hole in the bottom of container.

Step 4. Prime (hasty whip) one block of composition C4 with seven to ten turns of detonating cord, leaving a 6-foot pigtail for attachment to the ring main.

Step 5. Put the explosive charge into a plastic bag. Make a small hole in the bag, thread detonating cord through the hole, and tape the bag shut.

Step 6. Place the charge inside the container pulling the pigtail from the propelling charge back through the hole in the bottom.

Step 7. Install the pusher plate on top of the explosive charge.

Step 8. Fill the container with thickened flame fuel. Place the lid on the container, but do not lock it in place.

Step 9. Dig a trench at an angle that will give maximum effect over the area selected for coverage (25 to 45 degrees).

Step 10. Carefully lower the device into the trench, making sure the bottom of the device is against the back of the trench and the detonating cord from the explosive charge is not pinched or crimped.

Step 11. Straighten the detonating cord pigtail from the explosive charge out behind the trench.

Step 12. Stack 20 to 30 sandbags on and around the device, ensuring that the detonating cord is not buried.

Step 13. Place a ring main of detonating cord around the device.

Step 14. Attach the pigtail from the explosive charge to the ring main using a girth hitch with an extra turn.

Step 15. Using a 6-foot length of detonating cord, tape one end over the spoon handle of the igniter (M49 trip flare or (in combat) M34 WP grenade).

Step 16. Place a wooden stake near the device. Attach the igniter to it.

Step 17. Attach the igniter detonating cord to the ring main using a girth hitch with an extra turn.

Step 18. Remove the safety pin from the igniter.

Step 19. Attach two electrical blasting caps (that have been tested) to a firing wire using a common series circuit.

Step 20. Attach both electric blasting caps to the main line by making a loop in the detonating cord and attaching blasting caps to it. The device is now ready to be fired.

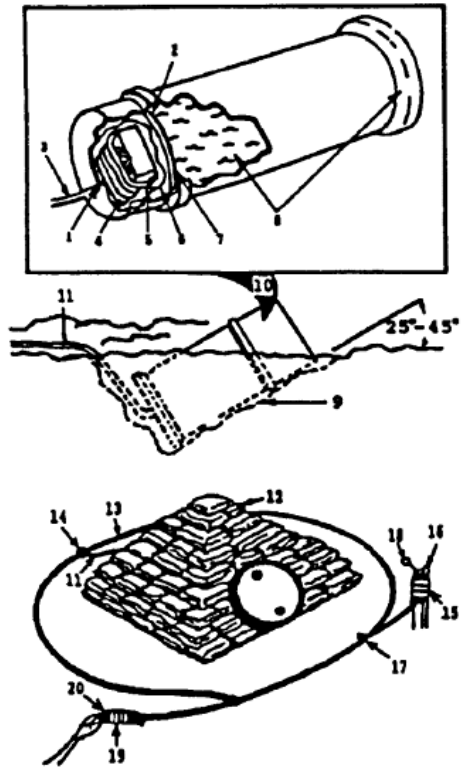

Figure 4-5. Example of a propellant charge fougasse. (Numbers correspond to steps in text.)

Area coverage is approximately 30 to 45 meters in diameter. Each propellant charge fougasse requires the following:

- metal cylinder or propellant charge container.
- Three gallons of gasoline.
- 100 feet of detonating cord.

- Two electric blasting caps.
- Nine ounces of M4 thickening compound.
- M49 trip flare or (in combat) M34 WP grenade.
- 1.25-pound block of composition C4.
- Twenty to thirty sandbags.

55-Gallon Container

To construct a flame fougasse using a 55-gallon container (Figure 4-6), follow these 17 steps:

Step 1. Prepare thickened flame fuel in a 55-gallon drum by mixing 150 ounces of M4 thickening compound to 50 gallons of gasoline while agitating it vigorously.

Step 2. Prime two blocks of TNT or composition C4 with seven to ten turns of detonating cord leaving 2 6-foot pigtails for attachment to the ring main.

Step 3. Dig a trench at an angle that will give maximum effect over the area selected for coverage (25 to 45 degrees).

Step 4. Dig a small depression in the back of the trench to place the explosive charge.

Step 5. Carefully place the explosive charge into the depression and straighten the detonating cord pigtail from the explosive charge up and out behind the trench.

Step 6. Carefully lower the device into the trench, making sure the bottom of the device is against the back of the trench and the detonating cord from the explosive charge is not pinched or crimped.

Step 7. Lift the device up. Place one sandbag under the front and hasty whip seven to ten turns of detonating cord around the top of the drum, leaving 2 4-foot pigtails.

Step 8. Remove sandbag and lower the device into place.

Step 9. Stack 100 to 120 sandbags on and around the device, ensuring that the detonating cord is not buried.

Step 10. Place a ring main of detonating cord around the device.

Step 11. Attach the pigtails to the explosive charge and the top of the drum ring main, using a girth hitch with an extra turn for each.

Step 12. Using a 6-foot length of detonating cord, tape one end over the spoon handle of the igniter (M49 trip flare or (in combat) M34 WP grenade).

Step 13. Place a wooden stake near the device. Attach the igniter to it.

Step 14. Attach the igniter detonating cord to the ring main using a girth hitch with an extra turn.

Step 15. Remove the safety pin from the igniter.

Step 16. Attach two electrical blasting caps (that have been tested) to a firing wire using a common series circuit.

Step 17. Attach both electric blasting caps to the ring main by making a loop in the detonating cord and attaching the blasting caps to it. The device is ready to be fired.

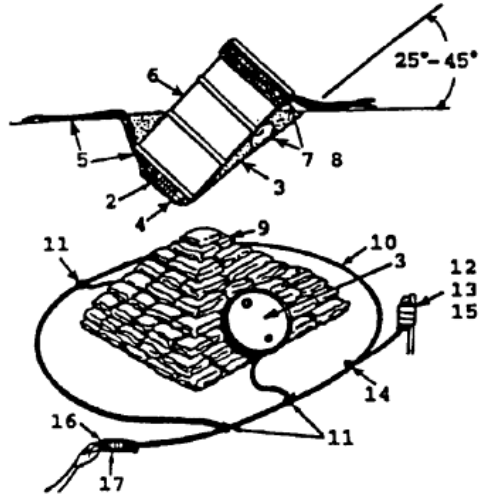

Figure 4-6. Fougasse made with a 55-gallon container. (Numbers correspond to steps in text.)

Area coverage is approximately 150 to 200 meters in front of the drum. Each 55-gallon flame fougasse device requires the following:

- 55-gallon drum.
- 50 gallons of gasoline.
- 100 feet of detonating cord.
- Two electric blasting caps.
- Two 1.25-pound blocks of composition C4 or two 1-pound blocks of TNT.
- 150 ounces of M4 thickening compound.
- M49 trip flare or (in combat) M34 WP grenade.
- 100 to 120 sandbags.

In combat situations, Claymore mine (M18A1) components can be used as the explosive charge at the drum bottom; it will detonate the expedient device and increase fragmentation effects. However, some method of ignition, such as an M49 trip flare or M34 WP grenade, is preferred.

Contact Devices

You may emplace all exploding flame devices for contact detonation as improvised flame mines. Since a lone soldier usually detonates a contact device, a 5-gallon oil can containing thickened fuel is sufficient. This weapon is most effective when positioned in open areas where obstructions will not decrease the fragmentation effect against personnel.

You will obtain the best results when you use the device in well-camouflaged positions approximately 2 meters (6 feet) above the ground in branches of trees, bushes, or hedges.

BUNKER BOMBS

Some forms of exploding flame devices lend themselves to a nonelectrical firing system rather than the electric method. One such device is the "bunker bomb." See Appendix A for further information on the nonelectrical firing system.

To construct the bunker bomb (Figure 4-7), follow these 7 steps:

Step 1. Fill the ammunition can three-fourths full with thickened flame fuel and secure the lid.

Step 2. Hasty whip the device with 15 turns of detonating cord around the center of the container, using 50 feet of detonating cord. Leave 2-foot pigtails for attaching the igniter and the nonelectrical blasting cap.

Step 3. Tape the igniter (M49 trip flare or (in combat) M34 WP grenade to the container handle.

Step 4. Place one detonating cord pigtail end over the igniter spoon handle. Tape it in place.

Step 5. Attach the M60 fuse igniter and the nonelectrical blasting cap to the M700 time fuse.

Step 6. Attach the nonelectrical firing system to the other pigtail by making a loop in the detonating cord and attaching the blasting cap to it.

Step 7. Remove the safety pin from the igniter (M49 trip flare or M34 WP grenade (in combat)). The device is ready to be fired.

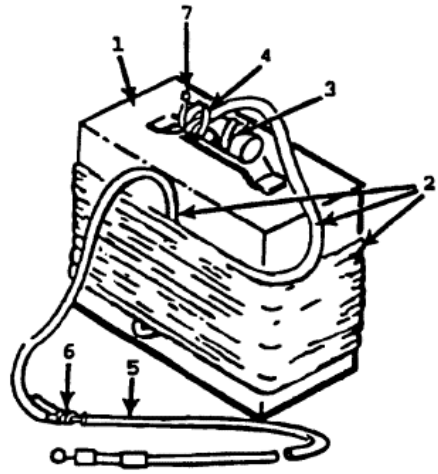

Figure 4-7. Example of a bunker bomb made from an ammunition can. (Numbers correspond to steps in text.)

WARNING

1. Carry the device only by the handle. Never use the igniter as a handle.

2. Remove the trip flare igniter safety pin only when it is time to use the device.

3. Use extreme caution when handling or carrying nonelectrical firing systems. Protect blasting caps from shock and extreme heat. Do not allow the time fuse to kink or become knotted. Doing so may disrupt the powder train and cause a misfire.

4. Prime detonating cord only when it is time to use the device.

5. Remove the time fuse igniter safety pin when it is time to use the device.

One ammunition can flame bunker bomb requires the following eight items:

- Small-arms ammunition container.
- Gallon of gasoline.
- Fifty feet of detonating cord.
- Nonelectric blasting cap.
- M60 fuse igniter.
- Seven and a half feet of M700 time fuse.

- Three ounces of M4 thickening compound.
- M49 trip flare or (in combat) M34 WP grenade.

Area coverage is approximately 5 to 10 meters in diameter. The bunker bomb is designed as a portable FFE device to be used during mobile defensive operations or raids into enemy rear areas during deep operations. This device is ideally suited for use in built-up areas during mobile operations in urban terrain.

CHAPTER 5

Flame Illuminators

The main purpose of flame illuminators is to provide extended burning time with maximum illumination, although they may also produce casualties. You may use flame illuminators for warning as well as illumination by contact detonation. This chapter discusses some improvised flame illumination devices used for limited battlefield illumination.

Flame illuminators vary and may be constructed of many differing components. FFE illuminators include 5- or 55-gallon flame illuminators, hasty flame illuminators, water illuminators, field expedient illuminators, Husch flares, and illuminated signal arrows.

5- OR 55-GALLON FLAME ILLUMINATORS

You can construct a flame illuminator (Figure 5-1) from a 5-gallon or a 55-gallon drum filled with thickened fuel, tightly sealed, and set into a hole with the top slightly below ground. Five turns of detonating cord are wound around the inside edge of the drum top and tightly tamped with mud. When detonated, the detonating cord cuts off the drum top and an M49 trip flare or M34 WP grenade (in combat only) placed on top of the drum, ignites the thickened fuel.

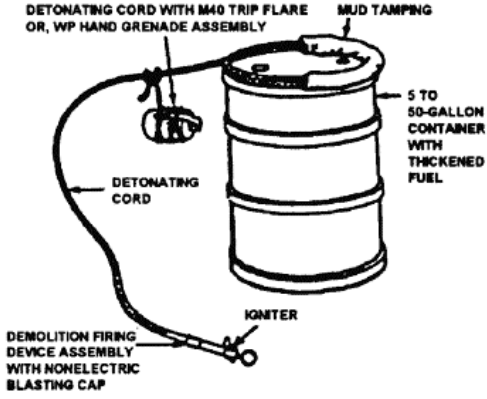
DETONATING CORD WITH M40 TRIP FLARE OR, WP HAND GRENADE ASSEMBLY
MUD TAMPING
5 TO 50-GALLON CONTAINER WITH THICKENED FUEL
DETONATING CORD
IGNITER
DEMOLITION FIRING DEVICE ASSEMBLY WITH NONELECTRIC BLASTING CAP

Figure 5-1. How to rig a 5- or 55-gallon flame illuminator.

The fuel will burn for several hours. However, you may control burning time somewhat by the size of container used, the thickness of the fuel mixture, and the addition of straw or dirt to the thickened fuel.

Each 55-gallon flame illuminator requires the following ammunition:

- 100 foot of detonating cord.
- Nonelectric blasting cap.
- Seven and a half feet of M700 time fuse.
- M60 fuse igniter.

- Electric blasting cap.
- 150 ounces M4 thickening compound.
- M49 trip flare.
- M34 WP grenade (in combat).

- 50 gallons of gasoline

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5- or 55-Gallon Flame Illuminator

Hasty Flame Illuminators

Water Illuminators

Field Expedient Illuminators

Husch Flares

Illuminated Signal Arrows

HASTY FLAME ILLUMINATORS

Construct hasty flame illuminators (fired within 24 hours after emplacement) by digging shallow holes or trenches in selected avenues of approach, filling with thickened fuel, and adding an igniter system. Can be ignited with electric blasting caps.

Ammunition requirements depend on the number of holes or trenches dug. Each device requires the following ammunition:

- Five feet of detonating cord.
- Nonelectric blasting cap.
- Seven and a half feet of M700 time fuse.
- M60 fuse igniter.
- Electric blasting cap.

- M49 trip flare.
- M34 WP grenade (in combat).
- Gasoline as required.

WATER ILLUMINATORS

Water illuminators are devices made by pouring gasoline, oil, or thickened fuel on the surface of calm water and igniting it. This hasty illuminator not only provides illumination but can be a formidable obstacle as well. Water illuminators should be used in combat only and not in training.

FIELD EXPEDIENT ILLUMINATORS

Use field expedient illuminators for defensive perimeters. Construct these devices using number 10 food cans, empty .50-caliber ammunition cans, or similar containers (Figure 5-2).

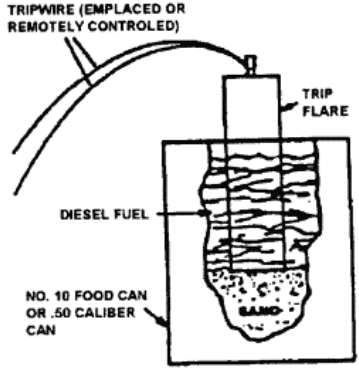

Figure 5-2. Sample field expedient illuminator.

Construct field expedient illuminators by filling the container halfway with sand, then filling the remaining with diesel fuel, and covering with paper. A trip flare is used to ignite the fuel. Each container should be strategically placed (with trip wires or wires for command-controlled detonation) at 50-meter intervals within the forward edge of a defensive perimeter.

On activation, these devices provide illumination for about 45 minutes.

HUSCH FLARES

The Husch flare (Figure 5-3) uses burning vapor of thickened flame fuel to provide battlefield illumination.

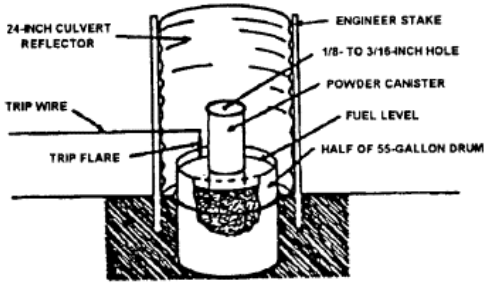

Figure 5-3. Cutaway, showing composition of a Husch flare.

Each Husch flare is constructed from a sealed metal container (powder canister) that is three-quarters full of thickened fuel and has a 1/8- to 3/16-inch hole in the top. Place the canister cap down in half of a 55-gallon drum that is three-quarters full of thickened fuel. A reflector assembly made from 24-inch culvert should extent about 24 inches above the top rim of the drum half. Husch flares can also be constructed with other similar components.

When you ignite the fuel in the drum half, heat from the burning fuel produces vapors within the canister. This vapor is expelled as a burning jet through the hole in the powder canister. Fuel in the drum half can be ignited with a trip flare.

The Husch flare, which is reusable, illuminates an area with a radius of about 50 meters for four to five hours. You can control burning time to some extent by the size of the container, the thickness of the fuel mixture, and the addition of straw or dirt.

ILLUMINATED SIGNAL ARROWS

An illuminated signal arrow (Figure 5-4) consists of a series of empty tin cans filled with an equal mixture of diesel fuel and JP4 (or equivalent) fuel. The number of cans on the stem of the arrow indicates the number of meters or increments to the enemy location (for example, each can may represent 100 meters).

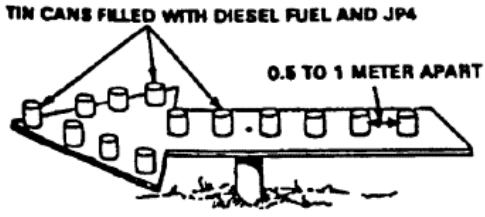

Figure 5-4. Example of an illuminated signal arrow.

When a unit is under attack, you must rapidly point the illuminated signal arrow in the direction of the attack and ignite the fuel in the cans. The arrow can be clearly seen by pilots of close air support aircraft. You may also use the signal arrow to mark landing zones and supply drop zones.

As the situation permits, you may arrange cans on an arrow-shaped board mounted on a spindle (Figure 5-4).

NOTE:
Distances per can should be stipulated in the unit SOP, SOI, or other guidance.

CHAPTER 6

Riot Control Agents

Riot control agents disable hostile forces or rioting personnel for limited periods of time by producing temporary disabling physiological effects when they come into contact with the eyes or skin or when they are inhaled. Their effects are typically peripheral, such as irritation to the eyes, mucosa, respiratory tract, or skin. The effects generally subside quickly once the individual is removed from the atmosphere of the RCA. On the other hand, incapacitating concentrations can act systemically, have longer lasting, more profound physiological effects such as immobilization of limbs, systemic interference of breathing, disruption of cognitive function or any of several other centrally controlled effects. The physiological effects may continue after personnel leave the target area. RCA levels at 5-10 milligrams per cubic meter (mg/m^3) achieve incapacitating concentrations. Training concentrations (1-3 mg/m^3) for CS are irritating concentrations normally found in chamber or field training exercise settings. In tactical concentrations, RCAs do not permanently injure personnel but should be used like incapacitating agents. In enclosed places, prolonged exposure to the resulting high dosages of RCAs can kill or disable personnel and can cause serious physiological reactions. Detailed descriptions of RCA munitions systems can be found in Appendix B.

STANDARD AGENTS

The standard RCAs currently in the US Army inventory are CS, CSX, CS1, CS2, and CR. The physiological effects desired and the dissemination means available determine the choice of RCA to use in a particular situation. Individuals having respiratory problems (such as colds, asthma, lung congestion, or heart conditions) may experience increased irritation and incapacitation upon exposure to these agents. Agent CN (popularly known as mace or tear gas) and its analog are considered obsolete for military employment; most CN munitions have been phased out of the system.

CS

In 1959, the US Army adopted CS (orthochlorobenzalmalononitrile) for combat training and riot control purposes. The Army has found it to be both safe and effective, especially for training and creating combat realism in low concentrations. Only CS in a capsule form may be used in the CS chamber. In Vietnam, CS was an effective incapacitant while its variable persistency made it an economical contaminant. Different forms of CS have different persistence characteristics, due to their formulation, dissemination, and rate of hydrolysis. CS is normally used either as a pure powder in bulk form or as pellets in a pyrotechnic mixture for employment in burning grenades and bomblets. A yellowish powdered solid in pure form, CS has a characteristic pungent pepper-like odor. Employed

in aerosol form, CS irritates the eyes, nose, throat, and (if used in sufficiently high concentration) will cause militarily significant incapacitation. By weight, the effectiveness of CS is about 10 times that of CN. The symptoms of exposure to training concentrations of CS are--

- Extreme burning of the eyes, with much tearing, coughing, and difficulty in breathing with tightness in the chest and pain in breathing.
- Involuntary closing of the eyes.
- Heavy mucous formation in the nose with sinus and nasal drip.
- Stinging or burning on moist skin areas.

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Standard Agents

Oleoresin Capsicum

Protection Against RCAs

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Treatment

Operational Considerations

Exposure to field concentrations may cause nausea and vomiting and prolonged exposure to CS on skin may cause severe irritation and blistering. Incapacitation is caused by the individual's inability to see or preoccupation with the agent's effects. Effects of the agent appear almost immediately and will continue as long as the individual is exposed. Affected individuals usually recover within 10 minutes in fresh air. CS has been specially formulated for varied dissemination characteristics and/or effects as CSX, CS1, and CS2. CSX is a form of CS developed for dissemination as a liquid rather than a powder. One gram of powdered CS is dissolved in 99 grams of solvent trioctyl phosphate (TOF) and is dispersed as a liquid aerosol from the M32 hand-held disperser (see Appendix B). As with CS, CSX causes stinging and irritation of the eyes, skin, nose, throat, and lungs of exposed personnel. It is only available in M32 hand-held dispersers.

Variations in the formulation of CS result in different persistencies for CS, CS1, and CS2. CS originating from burning munitions is disseminated only as an airborne cloud and its persistence depends mainly on air movement. The aerosol particles, once contacting the ground or other surfaces, adhere and do not re-aerosolize. Due to the relatively low volatility and rapid rate of hydrolysis, the CS aerosol usually presents a negligible residual hazard. However, a certain amount of caution must be exercised, since pockets of the airborne agent may linger in closed structures or other places where movement of air is slight.

CS1

CS1 has been specially formulated to prolong persistency and increase effectiveness. Unlike CS, CS1 is free-flowing agent powder (95 percent CS to 5 percent silica aerogel), that is readily usable in disseminating devices (for example, spray tanks) that require a free-flowing material. CS1 is CS blended with silicone-treated silica aerogel which not only prevents coagulation and increases fluidity, but also markedly increases its resistance to water. This form of CS prolongs the effectiveness for both immediate and surface contamination effects for direct and residual use. As CS1 settles out of the air, it readily contaminates terrain, vegetation, personnel, and equipment. When disturbed, CS1 re-aerosolizes to cause respiratory and eye effects.

CS1 exhibits typical CS activity for several days on dry ground at initial incapacitating concentrations (5-10 mg/m^3). Persistency tests have shown that CS1 can remain effective for about 14 days when used inside a dry tunnel or bunker and about 7 days on open terrain under ideal environmental conditions.

CS2

CS2 is far more resistant to water degradation, maintaining an effectiveness for a period approximately double that of an equivalent initial concentration of CS1. It is so resistant to wetting that when spread upon the surface of a body of water, agitation of the surface by wind or wading may regenerate an effective aerosol. CS2 will remain effective on open terrain under suitable conditions for about 30 days. Although rain does not effectively dissolve the agent, it may physically wash away from the site of deposit. High winds will dissipate it.

CR

In 1974, the US Army approved the use of CR (dibenz (b, f-1, 4-oxazepine) in riot control situations. CR has a stronger harassing action than CS. In addition, the toxicity of CR is lower than that of CS. CR is not used in its pure form (a yellow powder) but is dissolved in a solution of 80 percent propylene glycol and 20 percent water to forma 0.1 percent CR solution. As a solution, the operational flexibility of CR increases since it can be dispersed on the target areas as a liquid rather than as an aerosol cloud. CR is a highly potent irritant that affects the eyes, respiratory tract, and exposed skin. Eye pain, discomfort, and excessive tearing occur with sometimes painful sensitivity to strong light. Nasal irritation, coughing, sneezing, and nasal drip also occur. Exposure of the skin to CR results in a stinging or burning sensation with increased irritation on moist skin. Sometimes these symptoms are accompanied by nausea and vomiting, and can persist from 15 to 30 minutes. Severity of symptoms increases with the CR solution concentration in an environment of high temperature and humidity.

CR is quite persistent in the environment. The CR solution provides effective wetting and spreading of this agent on all surfaces. It does not degrade in water and can be considered

as persistent or more persistent than CS2. Under suitable conditions, CR can persist on certain surfaces (especially porous material) for up to 60 days.

OLEORESIN CAPSICUM

A possible nonstandard riot control agent is oleoresin capsicum (OC or pepper spray). This agent is most often used by the military police for incapacitating violent or threatening subjects, but also has applications for special forces and stability and support operations. OC is a naturally occurring substance found in the oily resin of cayenne and other varieties of peppers (can also be produced synthetically).

Contact with OC particles in a sprayed mist incapacitates subjects by inducing an almost immediate burning sensation of the skin and burning, tearing, and swelling of the eyes. When inhaled, the respiratory tract becomes inflamed causing the mucous membranes to swell. This restricts breathing to short, shallow breaths.

As stated earlier, standard RCAs also cause tearing and respiratory discomfort (irritant effects), but do not induce the inflammation and swelling effects of OC. When sprayed (OC is dispersed in hand-held canister similar to M32/36) most people cannot keep their eyes open unless they physically hold their eyelids apart due to the swelling. Fear and disorientation often result from this temporary blindness. Affected personnel may also lose strength and coordination due to the shortness of breath.

Treatment and decontamination procedures:

- Move to uncontaminated air.
- Flush face with cool water; if burning persists, use icepack.
- Do not rub area.
- Remove contacts, if applicable.
- Decon required areas with soap and water.

OC effects usually last approximately 15 to 45 minutes. If symptoms have not abated within 45 minutes, seek medical attention.

Limits of OC include:

- Alcohol-based sprays must not be used around flames/sparks.
- Effective range of OC is 4 to 6 feet (maximum range is approximately 25 feet).
- Personnel should not spray an individual closer than 2 feet from themselves to prevent being affected.
- Rain and wind decrease effectiveness.
- Eyeglasses/sunglasses may deflect agent (shift aim to nose/mouth).
- Perspiration may cause longer agent effects.
- OC may have detrimental effects on people with pre-existing respiratory problems.

As with any RCA, personnel must be properly trained on OC's capabilities/employment, limitations, and applicable rules of engagement/ARs prior to use.

PROTECTION AGAINST RCAs

Use the following measures to protect against RCAs. Protect the eyes and respiratory passages from CS by immediate masking. A dry field uniform will usually provide adequate protection for a short time in most tactical situations. Those personnel handling and loading bulk CS should wear protective clothing, masks, and gloves. Personnel exposed to CS1, CS2, and CR should wear protective clothing, masks, hoods, and gloves. Protective clothing should be secured at the neck, wrists, and ankles.

PHYSIOLOGICAL AND SAFETY CONSIDERATIONS

RCAs produce effects that must be considered for both tactical and training uses. The RCAs in training concentrations will produce temporary, irritating effects to normal, healthy individuals. These personnel will recover from the exposure quite rapidly. However, individuals with a common cold, asthma, lung congestion, high blood pressure, or cardiovascular problems will experience increased effects and may suffer longer recovery times. Therefore, they should not be exposed to these agents during training exercises. Pregnant soldiers with an exempt letter from a doctor should also be exempt from training with RCAs.

Particles of CS remaining on exposed skin for long periods can cause severe burns. CS should be immediately flushed from the skin with cold water.

Prolonged, continuous, or even intermittent exposure to field concentrations of CS combined with a high temperature and humidity may result in a cumulative effect (more intense stinging, tearing, watering of the eyes).

Food and drink contaminated with CS can be detected easily since it is quite repulsive to the taste. When food items are suspected to have been contaminated by CS in training, check them using the following procedures: (Do not use these procedures in combat when chemical or biological agents may also be present.)

- If packaged, clean the package and check for leaks or damage. If no odor is present, the food is probably not contaminated. If the package is damaged or leaking, unpack the contents and inspect them.
- If unpacked, sniff to detect RCA odor. If none the food may be safe to eat. However, when in doubt, discard the package. If the food is contaminated, you may be able to trim the food and remove the contaminated portions. The same procedures apply to food immersed in water or in covered containers. CR should be stored in nonporous containers on nonporous surfaces. It will leach into porous material and can be extremely persistent.

TREATMENT

Personnel exposed to RCAs should administer self aid/first aid and decontaminate as soon as possible. When exposed to CS, CS1, or CS2, personnel should administer self aid/first aid and decontaminate as follows: Upon exposure to these agents, don the protective mask, clear it, and try to keep the eyes open as much as possible. With or without the availability of a protective mask, move out of the contaminated area into fresh air and face the wind. When in a safe area, remove the mask and blot away tears; do not rub the eyes. If CS has entered the eyes, force them open and flush with water. Contact lenses are not approved for wear during training with CS. Minute particles can be trapped in the fluid between lens and eye, causing intense prolonged effects.

Chest discomfort can usually be relieved merely by talking. If exposure has been heavy, significant skin reactions may develop. Immediately flush the skin or exposed areas with large amounts of cold water. A 5-or 10-percent sodium bicarbonate solution in water or a specially prepared wash solution (6.7 percent sodium bicarbonate, 3.3 percent sodium carbonate, and 0.1 percent benzalkonium chloride in cold water) is superior to water and should be used only in small amounts. Do not use these solutions in the eyes. Oil-based lotions and skin decontamination kits containing bleach should not be used. CS reacts with bleach to form a combination more toxic to the skin than CS alone.

Decontaminate CS, CS1, and CS2 on surfaces and equipment using soap and water, especially for large area or surface decontamination. The higher the basicity of the decontaminant, the better. A more effective decontaminant for these RCAs on soil and clothing consists of 18 percent sodium hydroxide and 82 percent isopropyl alcohol (20 minute contact time). An alternate solution of cold water containing 10 percent monoethanolamine (MEA) and 0.3 percent non-ionic detergent (such as triton X-100 or Igepal CO-630) requires 30 minutes contact to be effective. Do not use chlorine bleach, oxygen bleach, standard decontaminants, or detergents containing bleach to clean up CS. These materials can react with CS to form chemicals that are more toxic than CS (for example, expoxides which cause vesicant (blistering) injuries).

Personnel exposed to CR should administer self aid/first aid and decontaminate as follows--

- Upon exposure to CR, personnel should mask (if available) and remove themselves from the contaminated area into fresh air. If CR has entered the eyes, flush them with large amounts of cold water or water containing 2 percent sodium carbonate while holding the eyelids opened.
- If the skin is exposed to CR, wash the exposed area gently with soap and cold water or use a deluge shower if available. Individuals who have ingested CR should be given lots of water or milk. Do not induce vomiting. Do not use bleach, bleach containing decontaminants, detergents, or peroxides for decontamination; this combination releases toxic fumes.

Physical removal of the CR solution is the only approved method of decontamination. To decontaminate CR on equipment or on surfaces, remove CR by using towels, rags, absorbent paper, or any other method such as scraping, shoveling, or sweeping. If

available, wipe the area with rags soaked in propylene glycol or an automotive antifreeze solution, then wipe with rubbing alcohol, and then scrub with non-bleach detergent and hot water before rinsing with large amounts of cold water. Even though physical removal eliminates most of the hazard, enough CR will remain to irritate the eyes. Wash hands thoroughly with soap and cold water before touching the face, eyes, or groin. Place all contaminated materials used to decontaminate in an approved storage container where they cannot affect personnel.

Soldiers who become highly contaminated with CS spray should remove their clothing as soon as feasible and take a shower or bath using plenty of soap and water. If contaminated, flush the eyes with large amounts of water. If exposure has been heavy, significant percutaneous (through the skin) reactions may develop. The individual may prevent this by immediately rinsing the skin with large amounts of water. However, 5 percent sodium bicarbonate or sodium carbonate in water or a specially prepared cutaneous wash solution is superior to water and is needed only in small amounts. Do not use such solutions in the eyes.

To prepare the cutaneous wash solution, add 100 grams of sodium bicarbonate, 50 grams of sodium carbonate, and 15 milliliters of 10 percent benzalkonium chloride to 1,500 milliliters of distilled water. This solution is stable and is prepared in advance, if needed. The pharmacy may issue without prescription. CS agents affect the eyes, the respiratory tract, and moist skin areas of the body. A field protective mask and field clothing with collar and cuffs buttoned and trouser legs tucked into boots will protect against field concentrations of the agents. Personnel handling or dispensing bulk CS wear rubber gloves, hood, rubber boots, rubber apron, protective mask, and field clothing secured at the neck, wrists, and ankles.

Those affected by CS should move to fresh air and face into the wind for 5 to 10 minutes, avoid rubbing eyes, and keep well apart from other affected personnel. If gross accidental contamination with CS agent occurs, promptly rinse the body with cool water. Remove the remainder of the agent, except in and around the eyes, with a 5 percent sodium bisulphite solution, then rinse the body with water. If sodium bisulphite is not available, use a 1 percent solution of sodium carbonate, sodium bicarbonate, or yellow general issue soap and water. When showering after any exposure to a CS agent, first rinse the body with cool water for 3 to 5 minutes before proceeding with normal showering. If agent residue is on the clothing, remove the clothing to prevent unmasked personnel from being affected. Showering and laundering of clothing after exercises will minimize the risk of skin irritation following exposure to CS. Soldiers who may be exposed to CS can reduce skin exposure by rolling down sleeves.

OPERATIONAL CONSIDERATIONS

The behavior and tactical effectiveness of RCAs in support of military operations are affected by the weather, by the terrain in the target area, and by the defense posture and training of target population. Understanding weather effects on RCA agent behavior is essential to ensure maximum effectiveness in planning and conducting operations.

Conditions that are most favorable for RCA dispersion and placement on a target would be stable (inversion) atmospheric conditions where the wind speed is less than 5 to 8 knots. Under neutral atmospheric conditions with low windspeed and smooth terrain, large areas may be covered with RCAs. Neutral conditions may be the best for military planning purposes since these conditions usually occur more often than stable or unstable conditions. The least favorable conditions for RCA employment are heavy rains and unstable (lapse) atmospheric conditions where windspeeds are greater than 10 knots. Although light rains will not seriously degrade the effectiveness of most RCAs, heavy rains will wash RCAs out of the air and off surfaces.

Temperature also has an effect on RCAs. Although the rate of evaporation of liquid RCAs increases with increasing temperatures, humans perspire more freely at higher temperatures, increasing skin effects from RCA exposure. In contrast, at lower temperatures, personnel will be wearing multi-layered clothing that provides a more effective barrier to skin exposure. In this case, RCAs may still be employed effectively for delayed harassing effects against troops who must eventually remove their contaminated clothing.

Terrain, contour, and surface areas also influence the effectiveness of RCAs. Under stable weather conditions, the agent cloud tends to flow over rolling terrain and down valleys. Higher concentrations tend to flow around obstacles such as hills and persist in hollows, low ground, depressions, and foxholes. In urban areas, the dominating terrain (buildings, streets, and trees) tends to channel wind and create eddies and currents that can be very unpredictable and cause the agent cloud to dissipate more rapidly. Turbulence on the downwind sides of buildings will tend to pool RCA concentration close to the buildings, and may penetrate closed structures through doors and windows.

Rough ground and ground covered with tall grass or brush tends to deflect and retard cloud movement, while flat terrain and open water (under stable or neutral conditions) allows an even, steady cloud movement and flow.

When RCAs are employed into wooded areas, the thickness and height of foliage determines agent effectiveness. A dense canopy tends to create a physical barrier that resists penetration of aerosol and particulate clouds from the outside while preventing escape of RCAs already under the canopy. The agent clouds released from munitions within woods and jungles are generally smaller and higher in concentration (by as much as three times) than those released in the open. Wooded and jungle environments also require larger munition expenditures because some rounds will detonate on treetops with less agent penetrating to ground level.

Soil type and condition also affect the efficiency of RCA munitions. For instance, point detonating devices tend to bury into the porous surfaces and evaporate more slowly than from nonporous surfaces. As a result, a decrease in the cloud size and area coverage could occur. When this soil is disturbed by traffic, the RCAs may become airborne with renewed effectiveness.

The overall utility of RCAs is greatly influenced by the discipline, motivation, and degree of readiness of the soldier. RCAs have been shown to be least useful against well-trained and well-equipped soldiers. Test results have shown that a very high level of adaptation or tolerance to CS may develop under conditions of extreme motivation or where escape to clean air is not possible. However, RCAs in surprise dosages can still incapacitate significant numbers of well-trained and equipped soldiers. Performance degradation will be achieved when enemy soldiers are forced to don protective clothing and masks. Enemy use of terrain may also be restricted. RCAs can also be used to complement or enhance other munitions beyond the effectiveness or either used alone.

In many tactical situations, the employment of RCAs cannot wait for optimum environmental conditions. Their effectiveness often depends on immediate use when and where the situation demands. When employed under adverse conditions, additional munition expenditures and off-target attacks may increase on-target RCA effects. However, RCA employment depends primarily on the tactical situation, regardless of the conditions that exist at the time.

CHAPTER 7

RCA
Employment

Specific techniques for employing RCAs in different situations are addressed in this section. This is only after the appropriate authority has given release for use of RCAs or a rules of engagement has been established.

AMBUSH RELIEF

Friendly forces may not be able to react with lethal fires because of the danger of collateral injuries. Mounted forces can react to ambushes with RCAs. E8 launchers can be placed on vehicles and properly oriented for immediate firing to the flanks. These E8-equipped vehicles are then spaced at intervals throughout the convoy, and can be command detonated if the convoy is ambushed. CS can also be used in support of withdrawal operations.

RIOT CONTROL

In conducting riot control operations the main objective is to "control" the rioting crowd into doing what we want, be that dispersing, grouping, moving, or channelizing. For further riot control guidance, see FM 19-15, *Civil Disturbances*, Nov 85.

Dispersing

The purpose of dispersing a rioting crowd is to have it break up and move off into different unorganized directions. The psychology behind a crowd is such that an individual is less emboldened to react with hostile intentions when alone than with a group of supporters.

In order to produce this dispersion, you must create a chaotic effect in the mind of the rioter so that he does not know which way to go or which way his comrades are going. To do this you can:

- Lob RCA agents into the center of the crowd.
- Attack the crowd with RCAs from different sides in coordinated staggered time intervals (as opposed to simultaneously).

Grouping

The purpose of causing a rioting crowd to group is to contain the area they will be able to affect, thus lessening the impact of their rioting and allowing you to focus your resources onto a smaller area.

In order to do this you must use RCAs to cut off different avenues of escape until you have contained the crowd.

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Ambush Relief

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Rescue Missions

Convoy Protection

Nuclear Weapons Security Operations

Military Operations in Urban Terrain

Base/Perimeter Defense

Terrain Restriction

Employing Small Area Munitions

Employing Dispersers

Moving

Moving the rioting crowd is akin to grouping, but instead of cutting off all avenues of escape for the rioting crowd, you leave obvious avenues open for the crowd to take. These obvious open avenues lead to where you want the crowd to go. This moving technique is used when you need to occupy the area the crowd is currently in or want them to move to a different location but do not have the assets to totally control them.

You can do this by first attacking the crowd from the opposite side you want the crowd to go as well as any avenues you do not want them to go.

Channelizing

This technique is used when you want a rioting crowd to move to a location you have chosen. Do this by cutting off avenues of escape with RCAs, blockades, and forces, as well as pushing the crowd from behind by using advancing forces and RCAs.

This technique can be resource intensive and cannot normally be accomplished without an adequate amount of available manpower and logistics.

RESCUE MISSIONS

For this manual's purposes, rescue missions are the tactical rescue of an encircled military force by another force which has freedom of movement.

An example would be a convoy that becomes surrounded and pinned down during movement. Unable to escape on its own, a rescue mission is required.

RCAs can be used in two ways to support a rescue mission:

- Supporting the concentration of combat power at the breakout point, used by the rupture force and support force.
- Supporting the delaying action of the rear guard.

The best time to conduct your rescue operation is as soon as possible to the actual encirclement. This limits the amount of time an enemy has to organize.

Supporting the Breakout Point

In supporting the breakout point or breach, RCAs may be used to cause confusion in the area where the rescuing force can concentrate his combat power. The RCAs are used by the rescuing force to break a hole in the enemy's lines, widen, and secure it.

Supporting the Delaying Action

Once the rescue force has successfully extracted the encircled force in order to further cripple the enemy's pursuit, RCAs may be used to delay and hinder their organization and movement. This is done by having the rear guard attack any pursuing forces with RCAs.

CONVOY PROTECTION

The key to protecting a convoy is immediate action when confronted with a situation which may endanger your mission or the lives of your soldiers.

In a situation where the road is being blocked and the convoy is being physically attacked (rocks, vehicles being shaken...) the use of RCAs can provide the necessary force to break contact with the attacking crowd. In breaking contact you should have your soldiers mask, deploy RCAs in your immediate area and in the direction you plan to move. Then move out in that direction, continuing to use RCAs along your path until it is clear.

NUCLEAR WEAPONS SECURITY OPERATIONS

Of all the instances where you may be allowed to use RCAs, this is probably the most serious. In protecting and recovering nuclear weapons, the use of deadly force will most likely already be authorized.

In protecting nuclear weapons, there must be clearly defined levels of force you will use--each level building on the last. The use of RCAs will be the last step in the escalation to the use of deadly force.

The rules of engagement given to you in the safeguarding and recovery of nuclear weapons will give you the guidelines for RCA use. You must understand that if you eventually must use lethal force, the phase of using RCAs must end and lethal force begin. There must be a clear distinction between the two operations (using RCAs and using lethal force), not only for legal purposes but for the psychological purpose of showing to the aggressor that the odds have changed. This in itself may cause an aggressor, not truly committed to this venue, to discontinue his actions.

MILITARY OPERATIONS IN URBANIZED TERRAIN

Combat in cities imposes unique demands because of urban setting. There are greater restrictions on the commander in the application of force for political and military reasons.

RCA use in cities can cause reduced effectiveness among enemy soldiers if they remain in the affected areas. Unprotected personnel, particularly those who do not have protective masks readily available, will probably move from cover or concealment--either to find their masks or to escape from the effects of the RCAs. The probable confusion and shock reaction among the enemy should also be detrimental to the enemy's effectiveness in holding an urban area.

RCAs may be preferable over conventional high explosives during MOUT. They can provide excellent capabilities for forcing hostile forces out of basements, sewers, and other subterranean systems. From historical accounts during *Operation Hue City*, missions were characterized by close, intense house-to-house fighting with engagements usually ranging from 20 to 150 meters. The closeness of the enemy and bad weather limited air and artillery support.

CS delivered by E8 launchers and grenades was employed extensively. When soldiers discovered the effectiveness of the CS delivered by launchers, CS was in high demand and had to be rationed. Assaults were usually preceded by direct and indirect fire, followed by CS, then a short pause followed by an infantry assault.

Smoke and RCAs may be employed together to obscure the vision of enemy direct tire gunners and forward observers. Smoke can also be used to screen RCA delivery. When the artillery displaces to positions behind the built-up area, RCAs and smoke can be used to screen their withdrawal. From battle reports, CS in 105mm projectiles was used in a counter-rocket and counter-mortar role during the defense of Saigon in March 1969.

The enemy placed his firing positions as close as possible to congested areas. Because conventional munitions would have caused significant property damage and could have inflicted casualties among civilians, CS was used successfully to suppress the enemy rocket and mortar fire.

BASE/PERIMETER DEFENSE

RCAs can provide valuable defensive fires when integrated into the perimeter defense of various types of fixed installations, including communications centers, airfield complexes, firebases, and support facilities. RCAs provide a rapid response to enemy activity when the exact locations of enemy or friendly personnel outside the defensive perimeter is not known. When used in this role, the munitions should be integrated into a deliberate defense plan.

TERRAIN RESTRICTION

The greatest amount of agent CS used in Vietnam was bulk CS1 and CS2, primarily for terrain and fortification restriction. Missions involving bulk CS were not directly exploited by maneuver units, largely because these missions supplemented economy of force activities.

The assessment of area restriction through use of CS was determined by observation of enemy movement in the target area. Intelligence reports, including airborne personnel detector readings and aerial photographs from Vietnam, indicated the enemy ceased to use lines of communication and other contaminated terrain after bulk CS bombing missions.

The enemy was sometimes observed using new trails to bypass interdicted routes. He was observed on other deeper targets scraping trails with bulldozers and washing down others in an attempt to regain unrestricted trafficability. These efforts were largely successful, but time consuming and costly, particularly when roads were covered by recon looking for targets of opportunity.

Occasionally, aerial reconnaissance of an CS-contaminated area revealed footprints and vehicle tracks in the agent, indicating that the enemy had traversed the contamination with no apparent attempt to remove the CS. This indicates that while contamination can restrict the use of terrain, only physical occupation by ground forces can deny its use. A determined enemy with masks would not be deterred from penetrating an area covered by CS. However, enemy troops would probably not stay long in an area heavily covered by CS.

CS2 can also be used to create contamination on the surface of stagnant or slowly moving water (for example, swamps, marshes, ponds). CS2 is highly resistant to degradation in water and will float on these surfaces for days. If the surface of the water is disturbed by foot or vehicle traffic, the CS2 powder will become airborne, renewing the inhalation

hazard. CS2 will eventually absorb water, lump up, and drift to the water's edge, but it can restrict use of water for short operations.

EMPLOYING SMALL AREA MUNITIONS

The following employment techniques are imperative for proper tactical use of small area RCA munitions such as grenades, launchers, and backpack dispersers:

- Sufficient munitions should be employed to completely cover the target area periphery, ensuring denial of escape routes and thorough coverage of the target's outer edges.
- Sufficient munitions should be employed against moving targets to blanket the entire area of possible movement.
- Use of reserve (additional) munitions should be planned to allow for wind drift of the agent cloud and to attack targets of opportunity.
- The agent cloud's similarity to white smoke should be exploited in helping to reduce target acquisition.
- The downwind incapacitation of enemy forces not in the target area should be considered in planning RCA employment against separate targets within a larger enemy formation or position.
- Timely exploitation of munitions effects by fire or maneuver. (About 10 to 15 minutes after the agent is employed, the physiological effects of CS no longer preclude military tasks from being performed.)

EMPLOYING DISPERSERS

Currently available dispersers are capable of delivering a high volume of CS or CR on crowds or terrain. They are designed to disperse agents from a position close to the target. Security should always be provided to the dispersing team.

CHAPTER 8

Herbicides for Contingency Use

Herbicides are chemical compounds used to kill/damage plants. They can be used to dry foliage, stimulate/inhibit plant growth, or sterilize soil.

Herbicides are grouped on the basis of required selectivity and modes of action. Required selectivity is broken into selective and nonselective. Selective herbicides target specific plant types, while nonselective herbicides affect all plant types. Modes of action are contact, translocated, soil sterilant, and pre-emergence. Contact herbicides require physical contact with the plant to be effective. A translocated herbicide is absorbed through the plant walls (stalk or leaves) and spread throughout the plant. Soil sterilant herbicides mail soil incapable of supporting plant life, while pre-emergence herbicides affect plants that have not germinated.

The Armed Forces Pest Management Board has approved three herbicides for contingency use: glyphosate, bromacil, and paraquat.

GLYPHOSATE

Glyphosate is the primary tactical herbicide that is used when feasible. Characteristics (see also Table 8-1):

- Relatively nonselective, translocated herbicide with little or no pre-emergence impact (crops can be planted/seeded directly onto treated areas following application)
- Applied as spray; visible effects usually occur within 7 to 10 days; however, effects are delayed by cool or cloudy weather. Available as a 41% solution that is further diluted with water before use.
- Applied through boom equipment in area spray missions on a spray-to-wet method.
- Controls vegetation for 2 to 4 weeks.
- Rainfall within 6 hours of application may wash it away.
- Mechanical agitators may cause excessive foaming.
- Corrosive to iron and galvanized steel and should not be stored for long periods in unlined containers. Flush sprayer parts with water after use.
- Leaching is very low and has strong soil absorption, but is subject to microbiological decomposition.
- Half life normally is 60 days or less.

Toxicity:

- Very low oral toxicity with no cases of poisoning being reported/observed. There is no specific antidote for oral ingestion.
- Avoid contact with skin, eyes, or clothing. In case of eye contact, flush with water for at least 15 minutes.
- No noticeable impact on wildlife/fish.

CONTENTS

Glyphosate

Bromacil

Paraquat

Availability

Mixing

Storage

Disposal

BROMACIL

This herbicide is the second choice of use. Characteristics (see also Table 8-1):

- Nonselective soil sterilant.
- Inhabits photosynthesis with effects appearing in 21-30 days; carried to root zone by moisture.
- Controls wide range of annuals, perennials, and certain woody plant species for about 12 months.
- Most readily absorbed through root system, but is also absorbed through leaves and stems; adding surfactant to spray will enhance foliar activity.
- Applied as spray on soil surface, preferably just before/during periods of active plant growth; available as 41% liquid solution that is further diluted with water before use.
- May be applied using spray tanks, boom sprayers, hand-held or high-volume equipment.
- Requires agitation only until mixed.
- Prolonged exposure to air can cause loss of water volubility.
- May corrode aluminum spray equipment.
- Flush spray equipment with several changes of water after use; clean glass with detergent followed by acetone rinse.

- Less subject to soil absorption than many other herbicides; is subject to microbiological decomposition, but usually persists for more than one growing season.
- Six months half-life.

Toxicity:

- Liquid form is harmful/fatal is swallowed.
- Eye, nose, throat, and skin irritant; wash thoroughly after handling.
- In case of contact, flush skin with water, flush eyes for 15 minutes, and get medical attention.
- Avoid breathing mist and avoid contact with clothing.
- Do not reuse containers.
- Do not apply, drain, or flush spray equipment around desirable vegetation; do not contaminate water supplies or bury empty containers near water.
- Open dumping is prohibited.
- Combustible; extinguish with chemical foam, dry chemicals, or carbon dioxide; firefighters must use self-contained breathing apparatuses.
- Slightly toxic to fish; no noticeable effects on wildlife.

PARAQUAT

A restricted-use herbicide used only in emergencies when benefits outweigh safety hazards. Characteristics (See also Table 8-1):

- Nonselective, contact herbicide with some pre-emergence and translocated effects.
- Only effective when applied to the aerial plant parts and action is light-dependent; in bright sunlight, first effects can be seen within an hour of treatment. However, plant death does occur slowly in the dark (most effective when applied in late after/early evening).
- Tenaciously bound by soil components by means of base exchange; considered to be biologically inactive in most soils, therefore, leaves no residue which would affect new seedlings or established crops.
- On broad leaf plants, 25 to 50% breakdown occurs in about 3 weeks.
- Readily absorbed by foliage and very resistant to rain removal; therefore, is ideal when rapid effects are needed or weather conditions are unfavorable for other herbicides.
- Applied on leaves during ground/aerial large-spray system, hand-held, or high-volume equipment. Available as a 20.1% solution which is further diluted with water before use.
- Non-ionic/cationic surfactant is recommended.
- Concentrated aqueous solutions are corrosive to many metals, including mild steel, tinplate, galvanized iron, and aluminum. Best kept in original container if undiluted.
- If diluted, is virtually noncorrosive to spray equipment.

- Slightly sensitive to ultraviolet light. Store in shady areas.

Toxicity:

- Highly toxic. One swallow can kill (symptoms include burning sensation in mouth followed by vomiting, diarrhea, and retching). However, inhalation or contact should cause no serious injury except when grossly exposed (inhalation effects are headache, nose bleeding, sore throat, and coughing. Systemic toxicity is not likely to occur from inhalation).
- Eye contact causes irritation/inflammation in 12 to 24 hours, but slow recovery usually follows while repeated/prolonged skin contact cause edema/erythema, cracking of fingernails/toenails. Immediately flush skin/eyes with water for 15 minutes and get medical attention.
- If swallowed, drink multiple glasses of water and induce vomiting. Repeat until vomitus is clear. Get medical attention. Reduce internal absorption by administering bentonite or activated charcoal.
- Serious poisoning may cause 2 to 3 weeks of transient kidney failure/liver complications with progressive pulmonary changes. Death is usually due to pulmonary fibrosis.
- Sprayers/handlers should wear full protective equipment (civilian or military).
- Concentrated paraquat is toxic to fish/wildlife; relatively safe when grossly diluted.
- Do not reuse containers. Untreated spill material can dry to form irritating dust. Mix spills with clay/clay soil and dispose as waste.

AVAILABILITY

- Herbicides are available through Defense General Supply Center (contingency stocks are not maintained).
- Procured in small containers of concentrate for shipment ease (heavily diluted before use).
- Normal mixtures are 5 gallon concentrate to 100 gallons water, but varies according to selected herbicide/application rate.

MIXING

When mixing water-soluble formulations, fill tank half full of water, add chemical slowly, and stir to dissolve. If detergent is recommended, add 1/4 to 1/2 pound of household detergent per 100 gallons spray. For aquatic weed control, herbicide concentration is often referred to as parts per million ppm), which is the number of parts (by volume weight) of chemical in one million parts dilute (mg/L). Use mixed solution as soon as possible due to strength loss/decomposition.

STORAGE

Store liquid formulations on pallets or duckboards to keep metal containers from rusting. Ensure containers are tightly closed (plug any air vents punched/opened to facilitate pouring) to prevent leaks.

Even small amounts of water contamination in concentrates/oil solutions can make them jell, causing container deterioration. Chemicals may crystallize out of solution below 32 degrees Fahrenheit. If this happens, warm concentrate and roll/shake containers. Crystals should return to solution. At high temperatures, chemicals may expand causing drum heads to bulge or leak, or at any temperatures above 95 degrees Fahrenheit, the chemicals may deteriorate. High temperatures may reduce any emulsifier's effectiveness and hasten container corrosion.

DISPOSAL

Herbicide waste, including contaminated soil/clothing and runoff, are mixed with absorbents (Fuller's earth, clay, and so forth) and buried in appropriate, approved landfills (IAW Federal, state, and/or local laws). Ensure containers are crushed/destroyed to prevent future use.

CHAPTER 9

Herbicide Delivery Systems

Systems available for the herbicide application can be broken into two general categories -- ground-based and aerial spray systems.

GROUND-BASED SPRAY SYSTEMS

Ground-based systems allow exact placement of herbicides and minimize downwind drift. Ground sprayers are employed in areas occupied and controlled by friendly soldiers on terrain traversable by the spray apparatus. A 500-meter buffer distance is recommended between the treated area and desirable vegetation. Applications are not made near desirable vegetation, in winds over 10 knots, or if it is about to rain. See Appendix D for a listing of ground sprayers.

Several hand-operated pump and pressure sprayers are available to deliver limited amounts of herbicides. Hand sprayers are suitable for spot spraying and for applying spray close to desirable vegetation. Sprayers could include sprinkling cans, compressed air sprayers of 1 to 5 gallon capacity, and knapsack sprayers with hand-operated pumps. Compressed air and knapsack sprayers are well adapted for herbicide use along highways, runways, or railroad tracks. A cone-type nozzle on a hand sprayer delivers 2.5 to 6 gallons per hour at 20 to 30 pounds per square inch (psi). If devices are issued for insect control purposes, clean them thoroughly after each use so that crops and vegetative camouflage are not damaged when they are used to spray insecticides.

Boomless sprayers with nozzle clusters are well adapted for spraying roadsides and ditch banks, under utility lines, and along fence rows. They are less expensive, simple to operate, and have less nozzle trouble than boom sprayers. They can pass between trees, maneuver close to obstacles, and are practical for rough terrain. They spray a broad swath of 20 to 30 feet with large volumes that provide moderately good coverage. The conventional equipment consists of a piston-type hydraulic sprayer equipped with 3/4-inch high-pressure hose and a 15 gallon-per-minute (gpm) pump for a 3/16-inch nozzle opening. Thirty-five to 60 gpm pumps are used for 1/4 inch, 5/16 inch, and 15/16 inch nozzle openings. The equipment is mounted on wheeled vehicles and the spray stream is greatly affected by the wind.

Truck-mounted boom sprayers are adapted for large areas where complete coverage is necessary, such as airfields, railyards, and depots. Arm booms are available for roadside and ditch spraying. Mounting the nozzles off-center enables the operator to spray 15 to 20 feet to one side. Use a larger boom mounted vertically to treat taller vegetation.

Handguns at about 100 psi can vary delivery from a broad mist to a narrow coarse stream from a stationary truck to reach into tight spaces. Higher pressures will increase drift and reduce delivery effectiveness.

Mist blowers are power-driven systems that disperse highly concentrate sprays. The herbicide is carried principally in an air stream instead of a liquid. These sprayer are free from boom and nozzle troubles and are very useful against weeds and woody plants in swamps and rocky areas along roadsides and under power lines. Mist blowers use very little water and cover vegetation rapidly. They are used to treat areas inaccessible to hydraulic power equipment and cost less. Mist blowers in sizes of 5 to 12 horse power (hp) are useful for brush treatment when drift is not a problem. A 2-hp knapsack mist blower is effective against brush up to 30 feet tall for spot spraying and for retreating.

CONTENTS

Ground-Based Spray Systems

Aerial Spray Systems

Any combination of pumps and spray nozzles may be mounted on any vehicle that has the capacity to transport them and the herbicide to the site of application and may be used as ground field expedients. Expedient systems are also used to spray fuels to bum treated or untreated vegetation. A standard highway watering truck can be adapted for herbicides by equipping it with a loading pump to circulate the spray material and standard asphalt nozzles that deliver a fan spray. Power-driven decontamination apparatuses (PDDA) are self-contained spray systems used to apply decontaminants. The M12A1 and the M17 lightweight decontamination system (LDS) are both adaptable for vegetation control. Tank capacities range from 200 to 1,250 gallons. The M12A1 also has a 35 gpm pump that can be remoted out from the prime mover to pump herbicides to pressures up to 800 psi. Delivery is made through two hoses with adjustable nozzles. The PDDA can be used to control vegetated minefield, defensive perimeters, airfields, and roadsides. Applications are made at volumes of 50 to 100 gallons per acre (as required) to completely wet the foliage. After using PDDAs for herbicide operations, clean them thoroughly to prevent damage to seals, hoses, and pumps. Once PDDAs have been used to deliver herbicides, they are no longer safe for transporting drinking or shower water. The PDDA is tagged with a warning and the warning is entered in the logbook.

AERIAL SPRAY SYSTEMS

Aerial spray offers rapid treatment of large areas for quick results at a lower cost. It also allows treatment of inaccessible areas and areas under enemy control. The obvious advantages of aerial spray systems are offset to some degree by the hazards to the pilot and the damage from the drift. A helicopter needs no runway and can fly better at low altitudes and in low visibility than fixed-wing aircraft, but at greater risk to the crew. For helicopter and small fixed-wing aircraft, area coverage is less than 5,000 acres per sortie. To achieve predictable herbicide deposit, aircraft should fly into the wind under

conditions as calm and stable as possible. See Appendix D for a partial listing of spray systems.

The only large fixed-wing aerial spray capability in DOD is maintained by the USAF in the Air Force Reserve. Specially modified C-130H Aircraft are equipped to use the Modular Aerial Spray System (MASS). The MASS can carry 2,000 gallons of spray liquid and can be configured to use wing and/or fuselage booms. The MASS has the capability of applying liquid from one-quarter ounce to 30 gallons/acre. Droplet sizes sprayed can vary from as little as 20 microns for ultra-low volume missions to as much as 3,000 microns for ultra-high volume missions. For aerial spraying, the C-130H is normally flown 200 knots constant ground speed 100-150 feet above the ground.

The US Army Pesticide Dispersal Unit (PDU) is a multi-capability unit that can be slung from the cargo hook of any helicopter using a six-foot nylon strap. It can be used to deliver liquids or solids and is configured in the high-volume mode using a 33.75-foot boom with up to 34 nozzles. The PDU operates in the ultra low-volume mode using a six-foot boom with two rotary atomizers and in the solid mode using a rotary disc slinger. The unit is self-powered by a 10 hp engine and is remote controlled by helicopter crew. The PDU has a liquid payload of 150 gallons and flow rates range from 0.48 gpm to 52.4 gpm. Since the PDU is an external load, contamination, jettison, and refilling problems are solved. The unit attaches in 15 seconds to all UH-1, UH-60, OH-58, and CH-47 helicopters. It is issued to preventive medicine units for pest control and can be used for herbicide operations along lines of communication, restrictive terrain, and in heavy vegetated areas to enhance intelligence collection and security.

A number of field expedient devices have been used in helicopters to spray small areas such as fields of fire around defensive perimeters, helicopter landing zones, and small crop destruction missions. These devices range from a 55-gallon drum equipped with a spray bar for temporary mounting across the skids of a UH-1 helicopter to a 400-gallon metal tank or 500-gallon collapsible fuel bladder with power-driven fuel transfer pumps and improvised booms for use on CH-47s.

CHAPTER 10

Tactical Employment of Herbicides

Upon proper approval authority, possible herbicide employment techniques may accomplish the following:

- Kill the vegetation bordering roads, paths, trails, railroads and waterways, thereby reducing possible sites from which friendly forces may be ambushed.
- Kill the vegetation surrounding vulnerable base camps, communications complexes, pipelines, supply points, assault strips, landing zones, and air defense sites. Use of herbicides would enhance security of these sites.
- Control vegetation in fields of fire and avenues of approach to create kill lanes which channelize enemy approaches and withdrawals. Properly integrated with terrain, obstacles, and fire support barrier plans, herbicides can enhance the lethality of direct and indirect fire weapons.
- Destroy large areas of dense vegetation for major construction projects or for health and sanitation programs. Herbicides may be used to mark areas through which roads are to be built. Herbicides may be used on enemy held terrain to support retaliatory operations by defoliating large area targets to improve intelligence gathering. Increased visibility, vertical and horizontal, in densely vegetated areas should make observation of enemy movements easier. Herbicide operation could also potentially restrict enemy use of ambush sites and infiltration routes.

Defoliation operations also support killing vegetation on friendly objectives and suspected enemy positions. Restricting the concealment opportunities often increased the chances of locating targets. Exposure of enemy supply depots, base camps, and other operations will make him more vulnerable to air attack.

Destroying enemy food supplies and cash crops when such objectives constitute proper military objectives is another option for use of herbicides. Herbicides reduce the enemy's ability to maintain an army in the field when food crops fail to mature and cash crops, such as drugs, cannot be sold to purchase arms and munitions.

Presidential approval is always required to employ herbicides in war, but host nation agreements may also require allied approval. Local civilian officials should be kept abreast of the effects of herbicide operations. Civil affairs provisions are made to provide food or money to families whose crops are accidentally damaged by herbicides operations.

Defoliation of heavily vegetated areas by use of herbicides is the primary means of obtaining visual observation of enemy forces, facilities, roads, ambush sites, infiltration routes, and other enemy locations from the air, ground, or water. The use of herbicides for defoliation--

- Enhances security. Defoliation of vegetation bordering and overhanging roads, path, trails, waterways, and railroads enhances security around friendly base camps, airfields, ammunition dumps, ports, along railroads, waterways and other locations by providing defense fields of fire and reducing possible ambush sites.
- Improve military intelligence. Defoliation of large-area targets improves military intelligence for plan and operations by increasing vertical and horizontal visibility in heavily forested or dense jungle areas. Defoliation also provides data for correcting existing maps for preparing new ones.
- Reduces enemy resistance. In defoliated areas, soldiers will meet less enemy resistance than in areas that have not been defoliated, and fewer soldiers will be required for operations. Exposure of the enemy's supply depots, base camps, and other locations will make him more vulnerable to air strikes and resultant damage, harassment, and threat of attack may cause him to move out of an area.

- Facilitates movement of military supplies. Defoliation along highways, railroads, and main shipping channels will facilitate movement of supplies and decrease the number of convoy guards required. Herbicides can also be used to reduce the enemy's food and industrial crops. This could cause him to divert combat manpower to production of food, depend on local food resources, become more stationary because of the necessity to cultivate hidden crops, and reduce production of war munitions.

APPENDIX A

Demolition Skills for Constructing Flame Field Expedients

Demolition Skills
for Constructing
Flame Field Expedients This appendix provides the basic demolition skills required to construct flame field expedients. For further information on explosives and demolitions, See FM 5-250, *Explosives and Demolitions*, Jun 92.

DEMOLITION ACCESSORIES

Available demolition accessories include time blasting fuses, detonating cord, blasting caps, a cap crimper, a blasting cap test set, two blasting machines, a detonating cord clip, a weatherproof fuse lighter, a l-gallon mine, a field incendiary burster, thickening compound, and demolition materials. This appendix describes these items, their packaging, and any precautions.

M700 Time Blasting Fuse

A time blasting fuse sends a flame from a match or igniter to a nonelectric blasting cap or other explosive charge and provides a time delay. The delay allows soldiers to move to a safe distance before the explosion.

The M700 time fuse (Figure A-1) is a dark green cord, 0.2 inches in diameter, with a plastic cover. Depending on the time of manufacture, the cover may be smooth with single bands around the outside at l-foot or 18-inch intervals and double bands at 5-foot or 90-inch intervals. The bands provide easy measuring. The burning rate is approximately 40 seconds per foot.

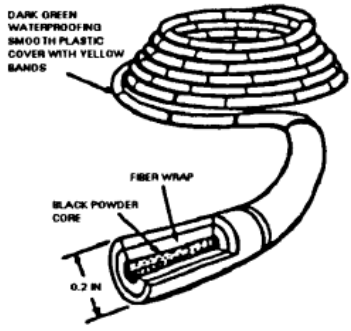

Figure A-1. Detail of M700 time fuse.

Time fuse M700 is packed in 50-foot coils, two coils per package, five packages per sealed container, and eight containers (4,000 feet) per wooden box.

CAUTION

You must always test the burning rate in the same manner as for a safety fuse. If burn rate is faster than 30 seconds per foot, do not use.

CONTENTS

Demolition Accessories

Misfires

Firing Systems

Testing Procedures

Priming Procedures

Detonating Cord

Detonating cord (Figure A-2) consists of a core of PETN or RDX in a textile tube coated with a thin layer of asphalt. Over this is an outer textile cover finished with a wax gum composition or plastic coating. Detonating cord transmits a detonating wave from one point to another at a rate of between 20,000 and 24,000 feet per second. Use it to prime and detonate other explosive charges. When you detonate its explosive core with a blasting cap or other explosive device, the detonation wave transmits to an unlimited number of explosive charges.

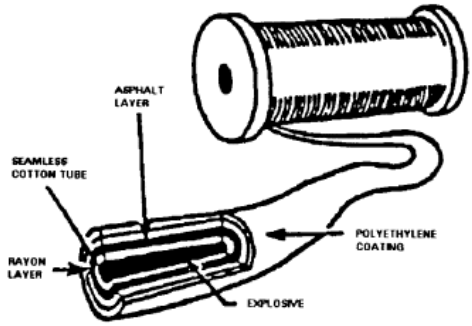

Figure A-2. Detail of detonating cord.

Detonating cord is packed in 1,000-foot spools, one spool per package, three packages (2,000 feet) per wooden box.

CAUTION

When using detonating cord to detonate underwater charges left in place several hours before firing, seal the ends with a waterproof sealing compound to keep out moisture. A 6-inch free end will also protect the remainder of the line from moisture for 24 hours. In priming, kinks or short bends that may sharply change the direction of detonation and thus cause misfires should be avoided.

Blasting Caps

Blasting caps are used for detonating high explosives. They are designed for insertion into cap wells and are also the detonating element in certain firing devices. Use the special military blasting caps to ensure positive detonation of the generally less-sensitive military explosives. Two types--electric (M6) and nonelectric (M7)--are used in military operations. Electric blasting caps are packed six per package (Figure A-3).

Figure A-3. Electric blasting cap.

M6 Electric Blasting Cap

Electric blasting caps have lead wires of various lengths for connection into a circuit. The most commonly used are 12 feet long. To prevent accidental firing, they have a short-circuiting shunt that you must remove before using the cap. If the cap is without a shunt, you may twist the bare ends of the lead wires together to provide the shunting action. The M6 special electric blasting cap (Figure A-4) is the standard issue electric blasting cap.

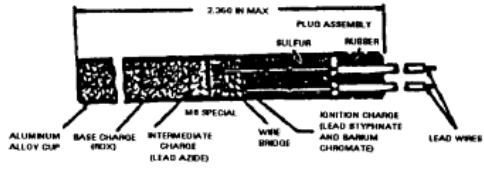

Figure A-4. Composition of M6 electric blasting cap.

CAUTION

Handle electric blasting caps with care. Blasting caps are extremely sensitive and may explode unless handled carefully. Like all blasting caps, electric blasting caps must not be tampered with and must be protected from shock, static electricity, and extreme heat.

M7 Nonelectric Blasting Cap

You may initiate nonelectric blasting caps by time blasting fuse, firing devices, and detonating cord. The M7 special blasting caps (Figure A-5) are flared at the open end to easily insert the time fuse. M7 caps are the standard issue nonelectric blasting caps.

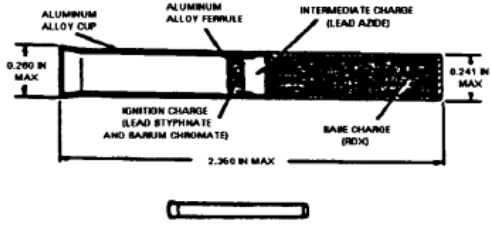

Figure A-5. Detail of M7 special nonelectric blasting cap (military).

CAUTION

Handle nonelectric caps with care. Blasting caps are extremely sensitive and may explode unless handled carefully. Do not tamper with caps and protect them from shock and extreme heat. Because they are difficult to waterproof, do not use these caps to prime charges placed underwater or in wet areas.

M2 Cap Crimper

The rear portion of each M2 cap crimper jaw (Figure A-6) is shaped and sharpened for cutting time fuses. Use the front portion of the jaw for crimping nonelectric blasting caps. A stop on the handle limits the closing of the jaws to prevent interference with the burning of the powder train in the fuse or detonation of the cord when crimping nonelectric blasting caps. One leg of the handle is pointed for use in punching cap wells in explosive materials for easy insertion of blasting caps.

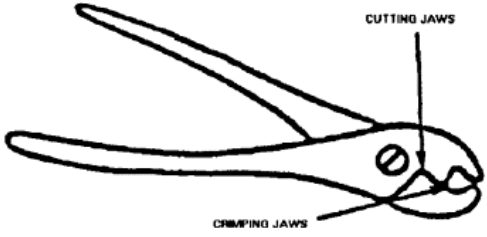

Figure A-6. M2 cap crimper.

Use the M2 cap crimpers to squeeze the shell of a nonelectric blasting cap around the time blasting fuse or detonating cord securely enough to keep it from being pulled off. The squeeze must not be enough to interfere with the burning of the powder train in the fuse or the detonation of the cord.

CAUTION

Because they are made of soft, nonsparking metal that will conduct electricity, do not use cap crimpers as pliers for any other purpose, as this damages the crimping surface.

M51 Blasting Cap Test Set

The M51 test set (Figure A-7) is a self-contained unit with a magneto-type impulse generator and two binding posts for attachment of firing leads. The test set is waterproof and may be used at temperatures as low as minus 40°F.

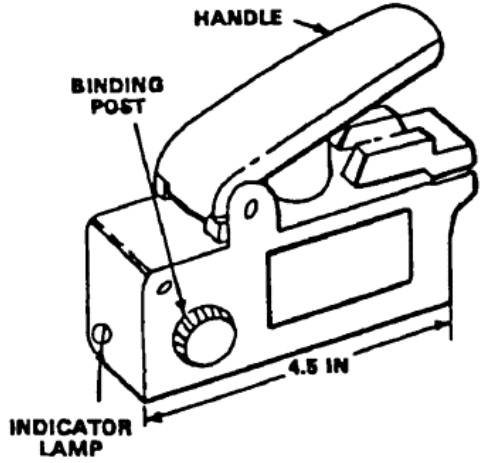

Figure A-7. M51 test set.

The test set was developed to replace the galvanometers for continuity testing of electrical firing circuits.

To ensure optimum useful life of the test set, keep it dry and handle it with care. Before using the set, ensure that it is in operating condition by following these three steps:

Step 1. Connect a piece of bare wire between the binding posts.

Step 2. Sharply depress handle while observing indicator lamp. If set is operative, lamp will flash.

Step 3. Remove wire and proceed to test firing circuit.

To perform continuity testing, connect the firing wires to the test set binding posts and depress the handle sharply. If there is a continuous, intact circuit, even one created by a short, the indicator lamp will flash.

M34 50-cap
Blasting Machine

The M34 blasting machine (Figure A-8) is a small DC electrical generator that produces adequate current (1.5 amperes) to initiate 50 electric blasting caps connected in series. It is 5 inches high and 2.5 inches wide.

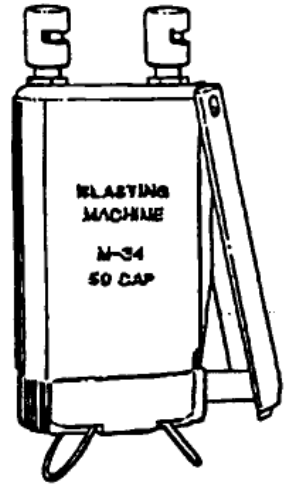

Figure A-8. M34 Blasting machine.

The M34 blasting machine is designed to detonate charges primed with electric blasting caps.

To ensure the machine works properly, perform steps 2 and 3 (*do not connect firing wires*). To detonate charges:

Step 1. Fasten the firing wires tightly to the terminals.

Step 2. Release the safety band from the handle bottom.

Step 3. Grasp the M34 blasting machine firmly with both hands and squeeze the handle vigorously several times until detonation occurs.

Detonating Cord Clip

The clip (Figure A-9) is a metal device that is approximately 2 inches long and 1 inch wide. It has a U-shaped bend at the top called a trough and a bend at the bottom called a tongue. The M1 detonating cord clip is used to hold strands of detonating cord either

parallel or at right angles to each other. You can make connections more quickly with these clips than with knots.

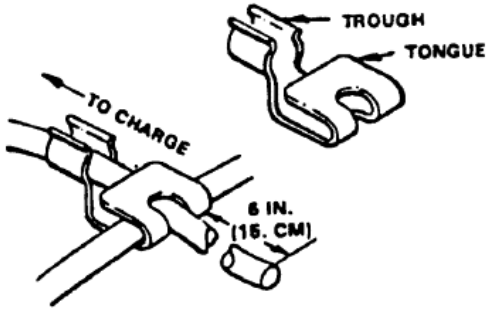

Figure A-9. M1 detonating cord clip used in branch-line connection.

Branch Lines

Connect branch lines by clipping the branch line with the U-shaped trough of the clip and the main line with the tongue of the clip.

Connecting Two Ends

Splice ends of detonating cord by overlapping them about 12 inches, using two clips, one at each end of the overlap, and bending the tongues of the clips firmly over both strands.

M60 Weatherproof Fuse Igniter

The M60 fuse igniter (Figure A-10) has a plastic body (barrel) 5 inches long with a safety pin attached through the barrel and the plunger. The plunger has a pull ring attached to it for easy use. The NSN is 1375-00-691-1671 and the DODAC is 1375-M766.

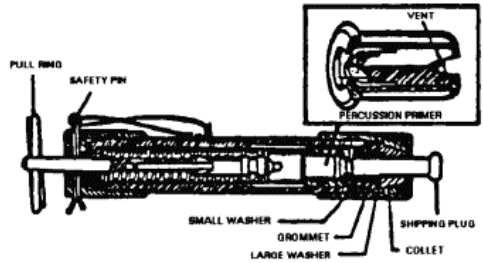

Figure A-10. M60 fuse igniter

The fuse igniter is designed to ignite time blasting fuses in any weather conditions and underwater if waterproofed. Operation is as follows:

Step 1. Unscrew fuse holder cap two or three turns but do not remove it. Press the shipping plug into the igniter to release the split collet, and rotate the plug as it is removed.

Step 2. Insert the free end of the time fuse in place of the plug until it rests against the primer.

Step 3. Tighten the cap sufficiently to hold the fuse in place, thus weatherproofing the joint.

Step 4. To fire, remove the safety pin, hold the barrel in one hand, and pull on the pull ring with the other, taking up the slack before making the final strong pull.

If there is a misfire, the M60 fuse igniter can be reset quickly without disassembly. Reset operation is as follows:

Step 1. Push the plunger all the way in and attempt to fire as before.

Step 2. If the M60 does not fire after three or four attempts to reset it, replace the igniter.

One-Gallon Mine

The 1-gallon mine (Figure A-11) is a rectangular 1-gallon can, 6 inches wide, 4 1/8 inches deep, and 10 9/16 inches high, fitted with a carrying handle and a threaded cap. Solder two short wires to the backside of the can for use when attaching a burster. You may fill one-gallon mine cans with thickened fuel to construct a flame mine field. The NSN is 1345-00-289-6938 and the DODAC is 1345-K260.

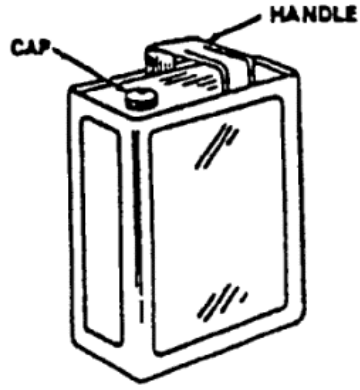

Figure A-11. One-gallon mine.

M4 Field
Incendiary Burster

The M4 field incendiary burster (Figure A-12) consists of a 12.25-inch by 1.25-inch burster tube assembly containing a plastic tube filled with tetryl pellets surrounded by a column of incendiary mix. It weighs 2.25 pounds. The burster tube has two bayonet-type fittings, a cap at one end, and a plug at the other. You may join two or more bursters together by removing the plug from one burster and the cap from another and coupling the open ends. A hole in the plug fitting accommodates the firing device, which may be a fuse, blasting cap, or detonating cord. A steel blasting cap adapter is furnished for each burster. The NSN is 1345-00-690-6909 and the DODAC is 1345-K010.

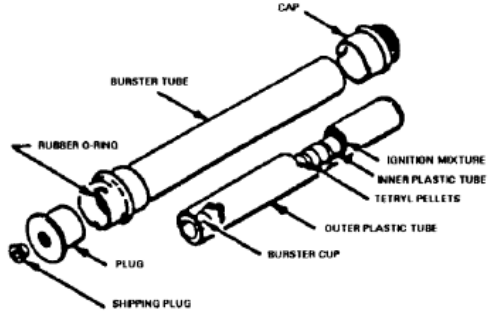

Figure A-12.
M4 field incendiary burster.

M4 field incendiary bursters are used primarily with field-improvised incendiary munitions filled with thickened fuel. The M4 bursts the fuel container, ignites the fuel, and scatters it over a large area. Each M4 burster has a bursting radius of 35 meters.

The M4 burster has a high-explosive filler. Handle it using the precautions given to high explosives.

WARNING

Handle with caution. The M4 burster has a high-explosive filler.

M4 Thickening Compound

M4 thickening compound is a fine, white powder. This dialuminum acid soap of isooctanic acid is a by-product of petroleum. It contains additives to prevent lumping. M4 thickening compound is used to convert liquid fuels to gels for use in flame field expedients. The NSN for the 2.5-pound can is 1365-00-926-4076, and the DODAC is 1365-K917. The NSN for the 25-pound pail is 1365-00-143-7139, and the DODAC is 1365-K920.

Demolition Materials

Units should plan in advance for the use of explosives and their components. (For training ammunition, base requisition procedures on unit and installation policies.) Two types of explosives used in the construction of flame field expedients are trinitrotoluene (TNT) and composition C4.

Trinitrotoluene

TNT is the most commonly used military explosive. It is employed as a bursting charge in constructing flame field expedients and as a standard explosive against which all other military high explosives are rated. TNT block demolition charges are issued in three sizes.

Uses. TNT block demolition charges are standard demolition charges and are used for all types of demolition work. The quarter-pound charge is used primarily for training purposes.

Advantages. TNT demolition charges (Figure A-13) have a high detonating velocity, are stable, and are relatively insensitive to shock or friction. TNT also has excellent water resistance and comes in convenient sizes, shapes, and packages.

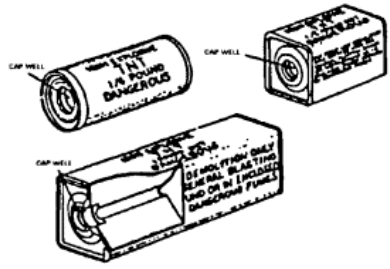

Figure A-13. Three sizes and shapes of TNT.

Limitations. Block demolition charges cannot be molded and are difficult to use on an irregularly shaped object. TNT is not recommended for use in closed spaces because the explosive gases are poisonous.

Composition C4

Composition C4 is a composite explosive containing 91 percent RDX and 9 percent nonexplosive plasticizers. Composition C4 replaced composition C3 as a demolition charge and may be used as a bursting charge. It is issued in two sizes: M112, 1.25 pounds, and M5A1, 2.5 pounds.

M112 Block Demolition Charge

The M112 (Figure A-14) block demolition charge consists of 1.25 pounds of composition C4 packed in a mylar film bag. On one surface there is pressure-sensitive adhesive tape protected by a peelable paper cover for quick emplacement. Composition C4 charges of old manufacturing dates are colored dull gray and are in a clear mylar bag. Charges of recent manufacture are white and packed in an olive drab mylar bag.

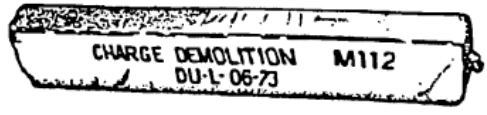

Figure A-14. M112 demolition block.

Uses. The M112 demolition block is used in all types of demolition work, primarily for cutting and breaching. Because of its moldability and high brisance (shattering effect), C4 is ideally suited for use as a bursting or propellent charge for exploding flame devices.

Advantages. M112 demolition block has an efficient shape and a handy size. It can be cut and molded for easy attachment to irregularly shaped objects. The color of the wrapper aids in camouflage.

Limitations. Its odd weight makes calculation of M112 charge weights difficult. Also, the adhesive tape will not adhere to wet or frozen surfaces. In addition, you should not use M112 in closed spaces because the explosion produces poisonous gases.

M5A1 Block Demolition Charge

The M5A1 consists of 2.5 pounds of C4 encased in a clear plastic container with a threaded cap well in each end. You can get bulk explosive by cutting open the plastic container.

Uses. Use the M5A1 in all types of demolition work, primarily for cutting and breaching. Because of its moldability and high brisance, C4 is ideally suited for cutting steel charges and for cutting irregularly shaped objects. C4 is insoluble in water and can be used for underwater demolitions.

Advantages. C4 is moldable from -20°F to +170°F. Because of its plasticity it can be cut and molded for easy attachment to irregularly shaped objects.

Limitations. The white color of C4 in demolition charge M5A1 is difficult to camouflage. Running water will erode C4 if it is not protected.

MISFIRES

Firing systems, whether electric or nonelectric, may occasionally fail to function properly. This creates a very hazardous situation. Handle misfires with extreme caution. You can reduce the possibility of a misfire by using combination dual-firing systems. To avoid misfires where charges are placed underground, use detonating cord to prime the explosive, keeping the blasting caps above ground.

Nonelectric Firing Systems

The most hazardous blasting operation is working on or near a misfire. If there is a misfire, delay investigation for at least 30 minutes after the expected time of detonation. This delay allows ample time for any explosion delayed because of a defective powder train in the fuse. Under certain combat conditions, however, immediate investigation may be necessary.

- Check all igniters and time fuses to determine if any did not burn.
- Check location of the blasting cap to determine if the primary was inadequate.

- For systems with detonating cord, locate the primed end of the detonating cord to determine if the blasting cap detonated but did not initiate the cord, or if the fault is in the initiating assembly.

WARNING

1. Only the individual who placed the charge should investigate and correct nonelectric misfires.

2. Anyone attempting to clear a nonelectric misfire must be trained in safe handling of explosives as well as the construction of nonelectric firing systems.

If the misfired charge is not tamped, lay a primed, l-pound charge beside it without moving or disturbing it, and again attempt to detonate the charge.

If the misfired charge has no more than a foot of tamping, try to explode it by detonating a new 2-pound charge placed on top. If this method is impractical, carefully remove the tamping using wooden or nonmetallic tools. Avoid accidentally digging into the charge. A constant check of the depth of the hole from ground level to the top of the charge will minimize the danger of striking the charge. When the charge has been uncovered to within 1 foot, insert and detonate a new 2-pound primer. Whenever possible, use detonating cord to prime underground charges and place the blasting cap above ground.

An alternate method of reaching a deep misfire is to dig a new hole within 1 foot of the charge and at the same depth. Place a 2-pound prime charge in the new hole to detonate the misfired charge. Use extreme care in digging the new hole to avoid striking the old misfired charge or placing the new charge too far away to induce detonation.

Electric
Firing Systems

To prevent misfires, one individual should be responsible for all electrical wiring of an FFE circuit. He or she should do all splicing to ensure--

- All blasting caps are included in the firing circuit.
- All connections between blasting cap wires, connecting wires, and firing wires are properly made. Short circuits are avoided.
- The number of blasting caps in any circuit does not exceed the rated capacity of the power source on hand.

Causes

Common causes of electric misfires include

- Blasting machine or power source inoperative or producing weak circuit output.
- Blasting machine or power source improperly operated.

- Defective and damaged connections causing a short circuit, a break in the circuit, or high resistance with resulting low current.
- Faulty blasting caps.
- Using blasting caps made by different manufactures on the same tiring circuit.
- Using more blasting caps than the power source permits.

Clearing

Because of the hazards from burning charges and delayed explosions, you must clear electric misfires with extreme caution. A burning charge may occur with the use of electric as well as nonelectric caps. Clear misfires of FFE charges primed with detonating cord and fired by electric blasting caps as follows:

Dual-Primed Charges

If the FFE charge is dual-primed electrically and below ground, wait 30 minutes before investigating; a burning charge may set off the second cap causing the main charge to detonate.

Single-Primed Charges

If the electric misfire is above ground and the FFE charge is not dual-primed, investigate immediately. If the system is below ground and not dual-primed, proceed as follows (12 steps):

Step 1. Check firing wire connections to the blasting machine or power source terminals to be sure contacts are good.

Step 2. Make two or three more attempts to fire the circuits.

Step 3. Attempt to fire again, using another blasting machine or source.

Step 4. Disconnect blasting machine firing wire. Before moving on to the FFE site, be sure you have shunted firing wires at the power source end of the circuit to avoid any possible static electric detonation.

Step 5. Check entire circuit, including the firing wire, for breaks and short circuits.

Step 6. If the fault is not above ground, very carefully remove the tamping material, if any, from around the FFE device, and avoid striking the electric blasting cap.

Step 7. Make no attempt to remove the primer or charge.

Step 8. If the malfunction is not located by removing the tamping material to within 1 foot of the charge, place a new electric primer and 2 pounds of explosive at this point.

Step 9. Disconnect blasting cap wires of the original primer from the circuit, and shunt the cap lead wires.

Step 10. Connect wires of the new primer in their place.

Step 11. Replace tamping material.

Step 12. Initiate detonation. Detonation of the new primer will fire the original charge.

Detonating Cord

Nonelectric or electric blasting caps attached to detonating cord may fail to function.

Nonelectric Blasting Cap

If a nonelectric blasting cap attached to detonating cord fails to function, follow these three steps:

Step 1. Delay investigation at least 30 minutes.

Step 2. Cut the detonating cord main line between the blasting cap and the charge.

Step 3. Fasten a new blasting cap with time fuse on the detonating cord.

Electric Blasting Cap

If an exposed electric blasting cap fastened to detonating cord fails to fire, follow these four steps:

Step 1. Disconnect the blasting machine immediately and investigate.

Step 2. Test the blasting circuit for any break or short circuit.

Step 3. Shunt the firing wire leads before leaving firing position to correct the problem.

Step 4. If necessary, replace the original blasting cap.

Failure of Branch Line

If the detonating cord main line detonates but a branch line fails, fasten a new blasting cap to the branch line; and fire separately.

Failure of Charge to Explode

If the charge is above ground and the detonating cord leading to the charge detonates but the charge fails to explode, follow these 5 steps:

Step 1. Delay investigation until certain the charge is not burning.

Step 2. If the charge is in the ground, wait 30 minutes.

Step 3. If the charge is intact, insert a new primer.

Step 4. If the charge is scattered by the detonation of the original detonating cord, re-assemble as much of the original charge as possible, place a new charge if necessary, and reprime.

Step 5. Make every attempt possible to recover all explosives scattered by misfire, particularly those used in training exercises.

Premature Detonation

Induced currents, lightning, or electric power lines may cause premature detonation.

Induced Current

The premature detonation of electric blasting caps by induced current from radio frequency (RF) signals is possible. Table A-1 shows the minimum safe distances in respect to transmitter power and indicates the distances beyond which it is safe to conduct electrical blasting, even under the most adverse conditions. This table applies to operating radio, radar, and television transmitting equipment.

Table A-1. Minimum safe distances.

Average or Peak Transmitter Power Watts	Minimum Distance to Transmitted (meters)
0–30	30
30–50	50
50–100	110
100–250	160
250–500	230
500–1,000	305
1,000–3,000	480
3,000–5,000	610
5,000–20,000	915

Mobile transmitters and portable transmitters are prohibited within 50 meters of any electric blasting caps or electrical firing system. If blasting distances are less than those shown in the table, the only safe procedure is to use a nonelectric system that cannot be prematurely detonated by RF currents.

Lightning

Lightning is a hazard to both electric and nonelectric blasting charges. A strike or a near miss is almost certain to initiate either type of system. Lightning strikes, even at remote locations, may cause extremely high local earth currents and shock waves that might initiate electric firing circuits. The effects of remote lightning strikes are multiplied by proximity to conducting elements, such as those found in buildings, fences, railroads, bridges, streams, and underground cables or conduit. The only safe procedure is to suspend all blasting activities during impending electrical storms.

WARNING

If you must transport electric blasting caps near operating transmitters or in vehicles (including helicopters) in which a transmitter is operated, then you must place the caps in a metal can with a snug depth of one-half inch. DO not remove the caps from the container near an operating transmitter unless the hazard has been evaluated and estimated to be acceptable.

Electric Power Lines

Do not conduct electric firing within 155 meters of energized power transmission lines. When it is necessary to conduct blasting operations at distances closer than 155 meters to electric power lines, use nonelectric firing systems or have the power lies shut off (see AR 385-63).

FIRING SYSTEMS

There are two types of firing systems: electric and nonelectric. Under normal conditions, construct FFE weapons using a dual-priming system.

Dual priming consists of two complete systems independent of each other and each capable of firing the same charge. It can be two electric systems, two nonelectric systems, or an electric and a nonelectric system. Dual priming increases the probability of a successful firing. Under emergency conditions or when equipment constraints make dual priming impossible, you may use single priming.

An electric dual-priming firing system consists of two independent electric circuits each with an electric blasting cap connected to a charge. The firing of either circuit will detonate all charges. Separate the firing wires for the two circuits to prevent the system from being cut by a single bullet or shell fragment. Place firing points at separate locations.

A nonelectric dual-priming firing system consists of two independent nonelectric systems for tiring a single charge or set of charges. If you are firing two or more charges simultaneously, lay out two detonating cord ring mains, and tie a branch line from each charge into each ring main.

A combination dual-priming firing system consists of an electric and nonelectric tiring system. Prime each charge both electrically and nonelectrically. Both electric and nonelectric systems are entirely independent of each other.

Electric Firing Systems

Electric firing systems detonate an explosive charge with an electric blasting cap. The basic priming materials consist of an electric blasting cap and a detonating cord.

Electric firing system basic assembly instructions include the following five steps:

Step 1. Prepare and place all explosive charges.

Step 2. Lay out firing wire from the charges to a predetermined firing position.

Step 3. Test firing wire as described in this appendix under "Testing Procedure."

Step 4. Test blasting caps that are to be used as described in FM 5-250.

Step 5. After blasting caps have been tested, twist the free ends of the cap lead wires together or shunt them with the short-circuit shunt provided to prevent an electric charge from building up in the cap lead wires.

Use the common series method to connect two or more charges fired electrically by a single blasting machine. Prepare a common series circuit by connecting one blasting cap lead wire from the first cap to one lead wire from the second cap and so on until only two end wires are free; then connect the free ends of the cap lead wires to the ends of the firing wire.

Nonelectric
Firing Systems

Nonelectric systems prime an explosive charge for detonation with a nonelectric blasting cap. The basic priming materials consist of --

- Nonelectric blasting cap and a time blasting fuse.
- M60 time blasting fuse igniter.
- Detonating cord (if more than one charge is to be detonated simultaneously).

To assemble the nonelectric firing system, follow these 10 basic assembly steps:

Step 1. Cut and discard a 6-inch length from the blasting fuse to prevent a misfire caused by the exposed powder absorbing moisture from the air.

Step 2. Cut off 3 feet of time blasting fuse to check the burning rate.

- *With* an M60 fuse igniter, attach the fuse to the igniter. Fire the M60 igniter and time the burning rate. Then compute the burning rate per foot by dividing the time in seconds by the length in feet.
- *Without* an M60 fuse igniter, split the end of the fuse, insert a match head into the split, light the match with another match, and note the time it takes the fuse to burn. Then compute the burning rate per foot by dividing the time in seconds by the length in feet.

Step 3. Cut the time blasting fuse long enough to permit the person detonating the charge to reach a safe distance by walking at a normal pace before the explosion. Make this cut squarely across the time fuse.

Step 4. Take a blasting cap from the cap box, and inspect it by looking into the open end. If foreign matter or dirt is present, hold the cap with the open end down and shake it gently or bump one hand against the other.

Step 5. Hold the time blasting fuse vertically with the square-cut end up and slip the blasting cap gently down over it so the flash charge in the cap is in contact with the end of the time fuse. It may misfire if not in contact. Never force the time fuse into the

blasting cap by twisting or any other method. If the end is flattened or is too large to enter the blasting cap freely, roll it between the thumb and finger until the size is reduced to permit free entry.

Step 6. After seating the blasting cap, grasp the time blasting fuse between the thumb and third finger of the left hand and extend the forefinger over the end of the cap to hold it firmly against the end of the time fuse. Keep a slight pressure on the closed end of the cap with the forefinger.

Step 7. Slide the second finger down the outer edge of the blasting cap to guide the crimpers and thus ensure accrate crimping even in darkness.

Step 8. Crimp the blasting cap at a point 1/8 to 1/4 inch from the open end (Figure A-15). Point the cap out and away from the body during crimping.

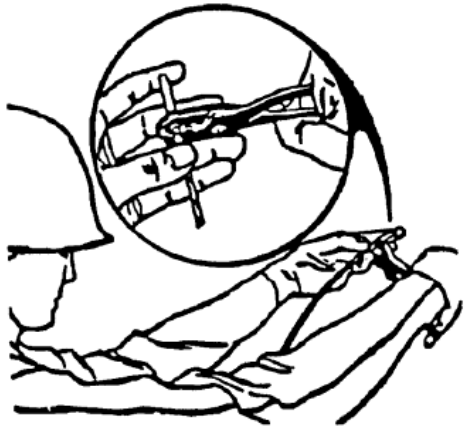

Figure A-15. Example of proper way to crimp a blasting cap.

WARNING

A crimp too near the explosive in the blasting cap may cause detonation

Step 9. Pass end of the time blasting fuse through the priming adapter. Then pull the cap into the cap well of the explosive, and screw the adapter into place. If no priming adapter is available, insert the blasting cap into the cap well and tie it in place with a string or fasten it with adhesive tape or other available material.

Step 10. Attach the M60 weatherproof fuse igniter as follows:

- Unscrew the fuse holder cap two or three turns but do not remove it. Press shipping plug into the igniter to release the split collet, and rotate the plug as it is removed.
- Insert free end of the time fuse in place of the plug until it rests against the primer.
- Tighten the cap sufficiently to hold the fuse in place and thus weatherproof the joint.

To fire the nonelectric system, remove the safety pin, hold barrel in one hand, and pull on the pull ring with the other, taking up the slack before making the final strong pull. If there is a misfire, the M60 can be reset quickly without disassembly by pushing the plunger all the way in and attempting to fire as before.

If a fuse igniter is not available, light the time blasting fuse with a match, using the following procedure: Split the fuse at the end, placing the head of an unlighted match in the powder train, and then light the inserted match head with a flaming match or by rubbing the abrasive on the match box against it (Figure A-16).

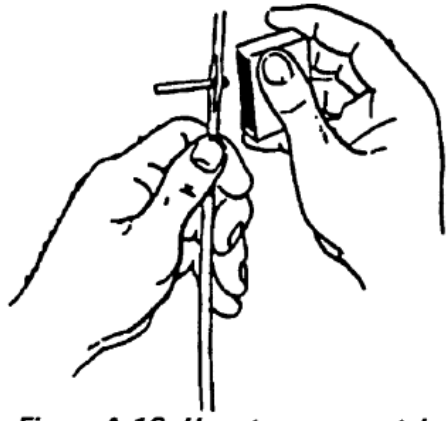

Figure A-16. How to use a match to light a time blasting fuse.

Detonating Cord Firing Systems

A detonating cord firing system is one of the most versatile and easily installed of all firing systems. It contains

- An electric system (an electric blasting cap, initiated by a blasting machine or other power source).

- A nonelectric system (a nonelectrical blasting cap initiated by a fuse igniter and a length of time blasting fuse). Use this method to initiate the detonating cord.
- Blasting caps, electric or nonelectric, attached to a point 6 inches from the free end of the detonating cord by numerous wraps of string, wire, cloth, or tape. The tip end of the cap must be in contact with the detonating cord.

Splices

Use a detonating cord clip or a square knot pulled tightly to splice the ends of detonating cord (Figure A-17). At least a 6-inch length must be left free at both sides of the knot. Then tape the free ends to prevent them from crossing over the detonating cord and thus cutting off the detonating wave at that point.

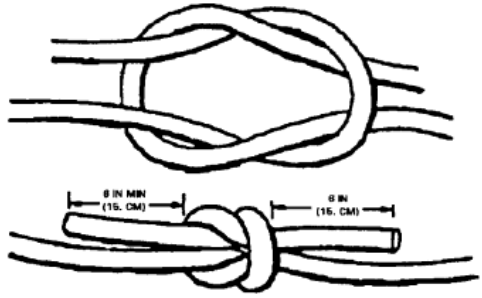

Figure A-17. Detonating cord splice using a square knot.

Fasten a branch line to a main line with a clip or a girth hitch with an extra turn (Figure A-18). The angle formed by the branch line must not be less than 90 degrees from the direction from which the blast is coming; at a smaller angle, the branch line may be blown off the main line without being detonated. At least 6 inches of the running end of the branch line is left free beyond the tie and taped down.

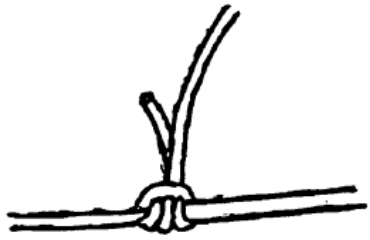

Figure A-18. Example of branch line connection, using a girth hitch with an extra

Ring Main

Make a ring main by bringing the main line back in a loop and attaching it to itself with a girth hitch with an extra turn (Figure A-19). This will detonate an unlimited number of charges.

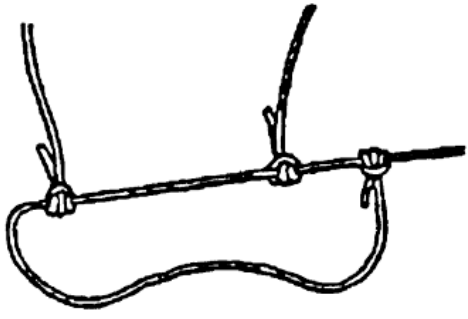

Figure A-19. Sample ring main with branch lines attached.

The ring main makes the detonation of all charges more likely because the detonating wave approaches the branch lines from both directions and the charges will detonate even if there is a break in the ring main. Make branch line connections perpendicular to the ring main. Avoid kinks in the lines, and curves and angles must not be sharp.

When making detonating cord branch line connections, avoid crossing lines. The cords may cut themselves and destroy the firing system.

TESTING PROCEDURES

Before priming an explosive charge electrically, carefully check all firing components. You must accomplish test procedures in the proper sequence. Otherwise, failure of the system or a premature detonation may occur.

Firing Wire

Use these procedures to test the firing wire of the M51 blasting cap test set and of the blasting galvanometers.

M51 Blasting Cap Test Set

Step 1. Check test set by connecting a piece of bare wire across the binding posts. The indicator lamp should flash when you squeeze the handle.

Step 2. Separate firing wire conductors at both ends and connect those at one end to the test set binding posts. Turn on the test set. Indicator lamp should not flash. If it flashes, the firing wire has a short circuit.

Step 3. Twist wires together at one end, connect those at the other end to the test set binding posts. Turn on the test set. Indicator lamp should flash. If it does not flash, the firing wire has a break.

Blasting Galvanometer

Step 1. Check galvanometers by holding a piece of metal across its terminals. If battery is good, the neddle will show a wide deflection of approximately 25 units (zero ohms).

Step 2. Separate firing conductors at both ends and touch those at one end to the galvanometers terminals. The needle should not move. If it moves, the firing wire has a short circuit.

Step 3. Twist the wires together at one end and touch those at the other end to the galvanometers terminals. This should cause a wide deflection of the needle-about 6.5 ohms or 23 to 24 units for a 500-foot length. No movement of the needle indicates a break, and slight movement indicates a point of high resistance that may be caused by a dirty wire, loose wire connection, or wires with several strands broken off at connections.

Electric
Blasting Cap

Use the following procedures to test the blasting cap of the M51 test set and of the blasting galvanometers.

M51 Blasting Cap Test Set

Step 1. Check the test set.

Step 2. Use the pointed handle of the M2 crimpers, make a hole in the ground deep enough to hold the entire blasting cap or have one sandbag handy.

Step 3. Remove electric cap from cardboard tube, wrap lead wires around fingers, and unwind lead wires from cardboard tube.

Step 4. Place the electric cap either in hole or under sandbag.

Step 5. Remove short circuit shunt from the lead wires of blasting cap.

Step 6. Attach one cap lead wire to one binding post and tie other lead wire to the other post. Squeeze test set handle. If the indicator lamp flashes, the blasting cap is satisfactory. If it does not flash, the cap is defective and you should not use it.

Step 7. Reshunt lead wires by twisting them together.

Step 8. Wrap lead wires loosely around cardboard tube and reinstall cap into tube. The blasting cap has now been tested and is ready for use.

Blasting Galvanometer

Step 1. Check the galvanometers for serviceability.

Step 2. Follow steps 2 through 5 described for the M51 test set.

Step 3. Touch one cap lead wire to one galvanometers post and the other lead wire to the other post. If the galvanometers needle deflects slightly less than it did when the instrument was tested, the blasting cap is satisfactory. If not, the cap is defective and you should not use it.

Step 4. Follow steps 7 and 8 described for the M51 test set.

Series Circuit

Follow these procedures to test series circuits of the M51 test set and the blasting galvanometers.

M51 Blasting Cap Test Set

Attach blasting caps lead wires to one binding post and tie other lead wire to the other post. Squeeze the test set handle. Indicator lamp should flash.

Blasting Galvanometer

Touch the free ends of blasting cap lead wires to one galvanometers post and the other lead wire to the other post. This should cause wide deflection in the galvanometers. If the galvanometers does not deflect widely, the circuit is defective.

Entire Circuit

Use the following procedure to test the entire circuit:

Step 1. Splice firing wires into a series circuit and move to firing position.

Step 2. When using the M51 blasting cap test set, connect the free ends of the firing wire to the binding posts. Squeeze the test set handle. Indicator lamp should flash. If the lamp does not flash, the circuit is defective.

Step 3. If the circuit is defective, shunt the wires. Then go down range and recheck the circuit. If you find a defective cap, replace it. Continue to test all caps and wires in the circuit. Then test the entire circuit again to make sure that you have found all defects before attempting to fire the charge. If you find a defective splice, resplice the wires using the Western Union pigtail method (Figure A-20).

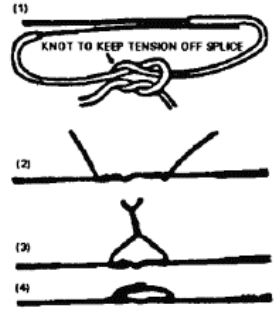

Figure A-20. Example of the Western Union pigtail method of splicing

Step 4. If you find a defective cap, replace it. Continue to test all caps and wires in the circuit. Then test the entire circuit again to make sure that you have located all breaks before attempting to fire the charge.

PRIMING PROCEDURES

You can accomplish the priming of high explosives through several approved techniques. The guidelines contained in this appendix explain and illustrate these procedures.

TNT
Demolition
Blocks

You can prime TNT demolition blocks either electrically, nonelectrically, or with detonating cord.

Electric Priming

As before, demolition blocks may or may not have threaded cap wells. If the blocks have threaded cap wells, use priming adapters if available. Proceed as follows:

Step 1. Untwist free ends of the lead wire and fasten them to the tiring wire.

Step 2. Pass the lead wires through the adapter slot and pull the cap into place in the adapter.

Step 3. Insert blasting cap into the explosive cap well and screw the adapter into place.

For demolition blocks without cap wells or priming adapters, complete the following procedures:

Step 1. If the block does not have a cap well, make one in the manner described for nonelectric firing.

Step 2. Untwist the free ends of the lead wire and fasten them to the firing wire.

Step 3. Insert the electric cap into the cap well and tie the lead wires around the block with two half hitches or a girth hitch with an extra turn. Allow some slack in the wires between the blasting cap and tie the wires to prevent any pull on the blasting cap.

Nonelectric Priming

Demolition blocks may or may not have threaded caps wells. Use priming adapters, if available, to secure the nonelectric blasting caps and the time blasting fuse to the demolition blocks with threaded caps wells.

If priming adapters are not available but blocks have threaded cap wells, prime them as follows (three steps):

Step 1. Wrap string or tape tightly around the block and tie it securely leaving about 6 inches loose on each end after making the tie.

Step 2. Insert the blasting cap with fuse attached into the cap well.

Step 3. Tie the loose string or tape around the fuse to prevent blasting cap from being separated from the block.

If demolition blocks do not have cap wells, follow this four-step procedure:

Step 1. With the pointed handle of the M2 crimpers, make a hole in the end of the block large enough to contain the blasting cap.

Step 2. Using string, wrap several turns around the explosive and tie any knot (or use tape). Position the tie so it will beat the top of the hole when the fused cap is inserted.

Step 3. Insert fused cap into the hole.

Step 4. Tie string (or use tape) around the time fuse at the top of the hole, with two half hitches.

Detonating Cord Priming

You may prime demolition blocks with detonating cord in several ways. The method that offers the greatest assurance of detonation is to affix a nonelectric blasting cap to the end of the detonating cord and place it in the demolition block similar to nonelectric priming methods. The system is then initiated by a nonelectric or electric assembly.

Common Method

To prime detonating cord with the common method, lay one end of a 4-foot length of detonating cord at an angle across the explosive. Give the running end three wraps around the block with the ends laying at an angle. On the fourth wrap, slip the running end under all wraps parallel to the other end and tighten it (Figure A-21). Initiate by an electric or nonelectric system.

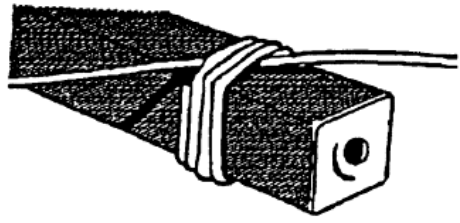

Figure A-21. Common method of detonating cord priming.

Alternate Method 1

To use the first alternate method, tie the detonating cord around the explosive block (on top of the booster if present) with a clove hitch with two extra turns. The cord must fit snugly against the block and the loops must be pushed close together (Figure A-22). Use an electric or nonelectric firing system taped into the loop made in the detonating cord to initiate the charge.

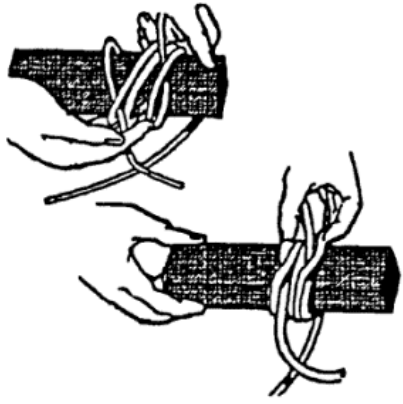

Figure A-22. Alternate method 1 of detonating cord priming.

Alternate Method 2 (Hasty Whip)

To use the hasty whip method, place a loop of detonating cord on the explosive with four wraps around the block and loop (Figure A-23). Pull the running end through the eye of the loop and tighten it. This method is also initiated by an electric or nonelectric system that is taped into a loop made in the detonating cord.

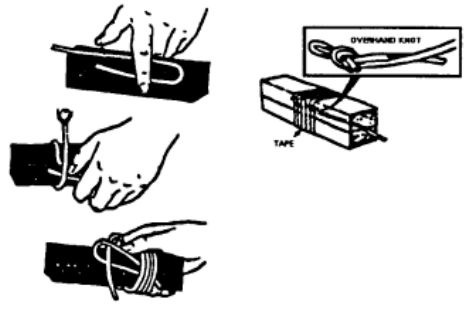

Figure A-23. Alternate Method 2 (hasty whip) of priming with detonating cord.

Composition C4
Demolition Blocks

You can prime composition C4 demolition blocks either electrically, nonelectrically, or with detonating cord.

Electric and Nonelectric Priming

Whenever whole or portions of C4 blocks are used, prime similarly to demolition blocks without cap wells. You can cut C4 with a knife and then form it into almost any shape.

Detonating Cord Priming

To prime composition C4 explosive with detonating cord, form the knot. Insert the knot into the block of explosive. Ensure there is at least a half inch of explosive on all sides of the knot.

APPENDIX B

Riot Control Agent Munitions and Delivery Systems

RCA MUNITIONS SYSTEMS

RCA munitions come in various forms such as bombs, spray tanks, artillery shells, mortar shells, rockets, grenades, and cartridges. The following systems are issuable RCA munitions currently available in the US Army, Navy, or Air Force inventory. Area coverages cited in munitions descriptions are areas where concentrations of at least 5-10 mg/m^3 occur (ICT_{50}).

HAND GRENADES

RCA grenades are classified either as burning type or bursting types. They are used against enemy personnel or material at relatively short ranges. Burning type grenades are usually fitted with igniting fuses which function with a 1-to-5 second delay. These grenades are usually thrown by hand or projected by a grenade launcher to the upwind side of the target. Upon ignition, the filler is ignited and sufficient pressure is created to uncover the gas ports and allow the RCA to escape. Burning type grenades will cause fires if employed around flammable material. Bursting type grenades are fused with delay fuses (1 to 2 seconds) which contain a low explosive detonator. The detonator ruptures the grenade body and dispenses the filler. These grenade are thrown into the air so that the burst occurs several feet over the target. Generally in a wind of 5 knots, the burning type grenade covers an area of about 10 meters wide to a downwind distance of 25 meters. Under the same conditions, the bursting-type grenade can cover an area about 5 meters in width to a downwind distance up to 15 meters.

M7A3

The M7A3 (Figure B-1), NSN 1330-00-965-0802, is a burning type grenade filled with approximately 270 grams (9.5 ounces) of pyrotechnic CS mix. In that mix there is about 116g (4.1 oz.) of pelletized CS. Housed in a metal cylindrical container, the M7A3 has a l-to-2 second delay fuse and a 15-to-35-second bum time. The throwing range of this grenade is about 35 meters. Area coverage: At a windspeed of 4 knots, the M7A3 grenade will produce an effective concentration over about 60m 2 in an elliptical pattern approximately 18 by 4 meters maximum crosswind width. At higher windspeeds, the pattern will be longer and narrower.

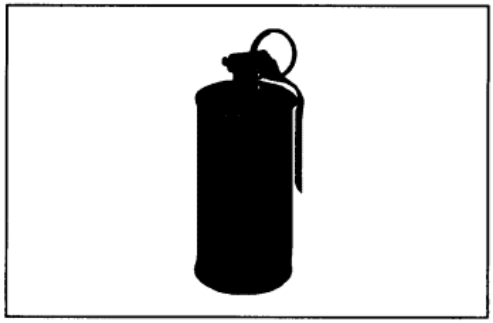

Figure B-1. Grenade, hand, riot, CS, ABC-M7A3.

M47

The M47 grenade (Figure B-2), NSN 1330-00-477-6704, is a special purpose, burning-type munitions used for control of rioters and counter-insurgents. It is filled with a CS pyrotechnic mix weighing about 410 grams (14.4 ounces) that contains approximately 120 grams of CS. The M47 consists of a rubber body assembly with a fuse delay of about 2 to 3 seconds before ignition. Discharge of the CS results in a random "skittering" of the grenade. The speed of the discharge through the ports prevents target personnel from picking up the grenade and throwing it back. The manner in which this grenade explodes also eliminates fragmentation side effects and minimizes fire hazards. The grenade bums from 8 to 20 seconds. Hand-throwing range of the grenade is about 35 to 45 meters. Area coverage: approximately 150 square meters. (Coverage may vary with field conditions and burn time.)

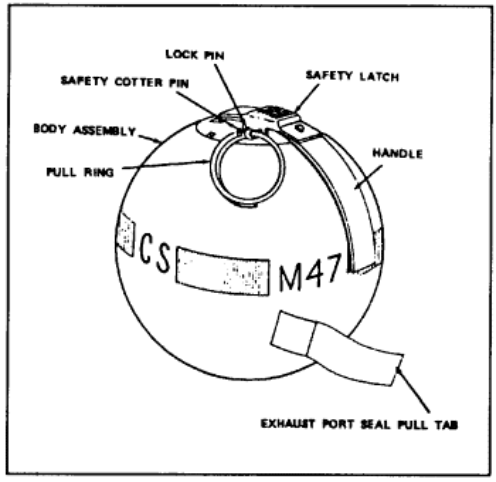

Figure B-2. Grenade, hand, CS, M47.

CONTENTS

RCA Munitions Systems

Hand Grenades

Cartridges

Mortar and Artillery CS Cartridges

Launchers

Dispersers

Field Expedients

M54

The M54 (Figure B-3) consists of an M7A3 grenade modified to accept an 8-to-12-second delay fuse. This modification permits hand-drop of the grenades from low performance aircraft at altitudes up to 1,500 feet, providing additional safety to aircrews. When dropped from this altitude, it begins to emit a cloud of CS at 50 to 100 feet. Like the M7A3, the M54 weighs about 1 pound and is filled with 115 g (4.1 ounces) of pelletized CS in a pyrotechnic mix. It burns for about 15 to 35 seconds. Area coverage: Same as the M7A3.

Figure B-3. Grenade, hand, 8- to 12-second delay, CS, M54.

CARTRIDGES

The cartridges described below are projectiles filled with RCA that can be launched from rifle-equipped grenade launchers, and allows deposition of RCAs on targets with increased accuracy and at ranges beyond grenade throwing distances. Due to the projectile's high velocity, it will penetrate barriers of wood and glass. Exercise caution when using these projectiles in training and riot control situations. They can cause serious injury or death at close range. These cartridges are especially effective when fired into enclosed areas such as buildings, houses, bunkers, caves.

M651

The M651 (Figure B-4), NSN 1310-00-849-2083, is a 40mm, 11.3-cm-long aluminum cartridge filled with about 53 grams (2 ounces) of CS pyrotechnic mix containing approximately 21 grams of CS. It is equipped with a point detonating fuse (M581) and can be fired from the M79 and M203 grenade launchers. Maximum accuracy is obtained at ranges up to 200 meters. Area targets may be engaged up to 400 meters. This projectile can penetrate window glass or up to 3/4 inch-thick pine at 200 meters and still release CS. Following impact, a cloud of CS is emitted for approximately 25 seconds. Area coverage: approximately 120 square meters. Two cartridges effectively placed will incapacitate 95 percent of unmasked personnel in an enclosure of 15 by 30 by 20 feet within 60 seconds after functioning.

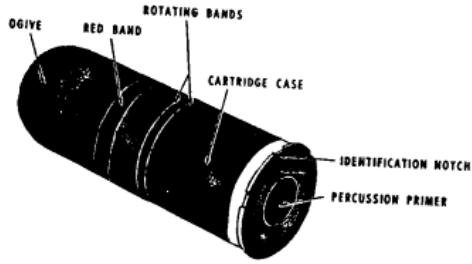

Figure B-4. Cartridge, 40mm; CS, M651.

M674

The M674 (Figure B-5), NSN 1310-00-935-9229, also known as the Handy Andy is an aluminum tube that contains a rubber projectile filled with about 90 grams of CS pyrotechnic mix (about 36-45 grams CS). It can be fired from the M79 grenade launcher, from the AN-M8 pyrotechnic pistol, or thrown by hand. It has a 2-to-7 second delay before the CS pyrotechnic mix ignites, and a range of about 70 meters. Unreliable ranges and lack of precision make the M674 a much less effective munition than the M651. If the M651 is not available, the M674 can be used on targets similar to those attacked with the M651. Area coverage: approximately 120 square meters.

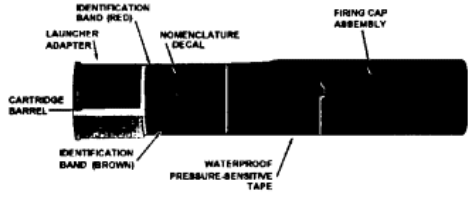

Figure B-5. Cartridge, 40mm, riot control CS, M674.

MORTAR AND ARTILLERY CS CARTRIDGES

M630

The M630 (Figure B-6) is fired from an M30 4.2-inch mortar and ejects four l-pound CS-filled pyrotechnic mix canisters either on impact or at a preset altitude of 120 meters

above ground level. A total of 1.6 pounds of CS can be dispersed with this cartridge. The M630 cartridge consists of the M633 projectile, M2A2 ignition cartridge with an M36A1 propelling charge, and the M548 variable time fuse. The fuse functions at either a preset time or upon impact to ignite the mix which will burn for about 60 seconds. It has a maximum range of 5,650 meters.

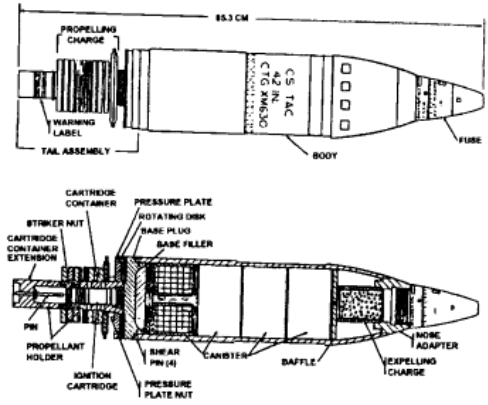

Figure B-6. Cartridge, 4.2-inch, tactical CS, M630; with fuse, MTSQ, M548.

The M630 is used for direct support of maneuver elements on known or suspected targets to harass or confuse the enemy so that his ability to fire and maneuver is degraded and his vulnerability to friendly fires is increased. The M630 will penetrate a triple canopy jungle and is effective against enemy night attacks. It is also used for counter-battery and counter-mortar fire. It can be used in both an offensive and defensive role.

M629

The M629 (Figure B-7) is a semi-fixed, base ejecting round designed for use in all 105mm howitzers. The main components of the round are the M632 projectile containing four M8 pyrotechnic filled canisters (each containing about 375 grams of mix), a cartridge case, and an M548 variable time fuse. A total of 1.3 pounds of CS is contained in the cartridge. The fuse functions either at a set time or upon impact to ignite the expelling charge. The pyrotechnic mix burns for about 60 seconds.

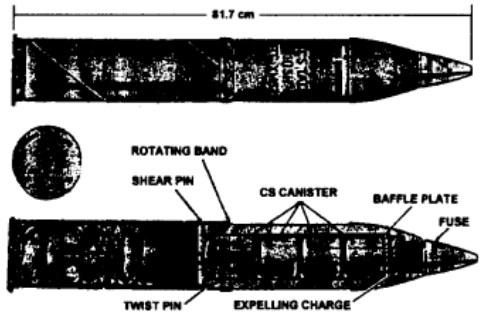

Figure B-7. Cartridge, 105mm, tactical CS, M629; with fuse, MTSQ, M548.

The 105mm cartridge can be used to route the enemy from cover, for close support, and is especially effective in search and clear operations. It is also used for harassing and interdiction and counter-battery and counter-mortar fire.

LAUNCHERS

E8 Launcher and 35mm Cartridge: Tactical CS

The E8 launcher (Figure B-8) is a man-portable (34 pounds), ground employed, expendable munition that can be fired either electrically or manually. The E8 launcher is a short-range weapon that can be used to place quantities of CS on point and small area targets in conjunction with assault by ground forces. The launcher may be emplaced, sighted, and fired by one man. The E8 consists of a launcher module and a firing platform with a carrying harness and backpack attached. The launcher module has 16 tubes, each containing four E23, 35mm CS cartridges, for a total of 64 cartridges. Each cartridge is filled with 38 grams of a CS pyrotechnic mix of which 15 grams are pure CS. The total fill (CS pyrotechnic mix) is .97 kg (2.1 pounds). The expelling charge propels the cartridge from the launcher and ignites a 5-to-6-second delay fuse in the cartridge. The CS pyrotechnic mix burns from 10 to 15 seconds. The cartridges contain different amounts of propellant charge to give a wider dispersion in the target area. The elliptical pattern created from the cartridges fired from the E8 launcher is relatively independent of meteorological conditions. However, the period of effective agent concentration on a target area is dependent upon existing meteorological conditions. The range of this launcher is from point blank to 250 meters based on adjustable firing notch position (six positions available).

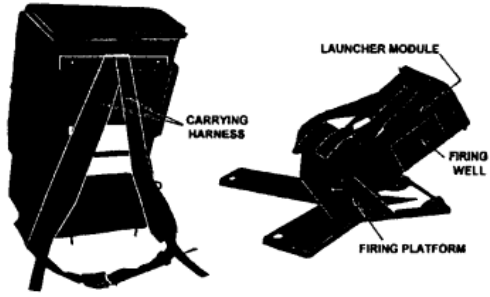

Figure B-8. Launcher and 35mm cartridge, tactical CS, 16-tube, E8.

Area coverage: At 40° elevation, 40m wide by 125-175m deep. Use: Its use has been quite effective in perimeter and convoy security, counter-ambush, combat assault. The E8 has also been used in ambushes and to break contact.

M234

The M234, NSN 1010431-014-6506, system consists of the M234 64mm projectile launcher, the M743 64mm kinetic energy projectile, the M742 64mm kinetic energy projectile filled with CS1, and the M755 blank cartridge.

The M234 64mm projectile launcher is a launcher from which 64mm projectiles can be fired from an M16A1 rifle. It is aluminum-tasted, cylindrical, and weights approximately 2.5 pounds. A nut and latch mechanism holds the launcher onto the barrel of the M16A1 from which the M742 or M743 projectiles are fired.

The M743 64mm kinetic energy projectile, (Figure B-9) also called the Sting Rag (ring airfoil grenade), was designed to inflict a painful blow upon impacting on a target individual. It consists of a rubber-like plastic material, 64mm in diameter, molded in the form of a ring airfoil. The airfoil shape of the spinning projectile provides life during the flight, enabling it to overcome gravity and result in a relatively straight trajectory. Upon target impact, the circumferential breakband fractures, allowing the projectile to deflect and spread the impact load, inflicting pain but minimizing the possibility of causing serious injury. It can be aimed accurately at individuals up to 40 meters away and up to 60 meters for groups of personnel. It has a maximum range of 100 meters. This projectile is called a kinetic energy projectile since it has nearly the same energy impact at effective ranges as it has at launch, due to its airfoil shape that results in a low draft profile.

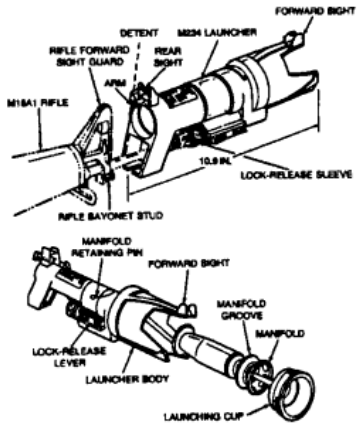

Figure B-9. Soft RAG/Stin RAG (Ring Airfoil Grenade) System.

The M742 64mm kinetic energy projectile filled with CS1, also called the Soft Rag, is designed to deliver small quantities of CS1 to target personnel at ranges identical to that of the M743. The projectile is filled with approximately 2 grams of powdered CS1 which is equally distributed in 18 pockets or compartments around the circumference. The breakband is designed to rupture on impact and release the CS1 in a 3 to 5 feet diameter cloud. This item was designed for use in controlling individuals and crowds during civil disturbances. It has some applications for special operating forces and point-type targets when casualties are not desired.

The M755 blank cartridge provides the propelling force for the projectile and is specifically designed to launch it from the M16A1 rifle. *Ball ammunition must not be issued to soldiers using the M234.*

DISPERSERS

Dispersers provide another means for disseminating RCAs in sufficient quantities to provide effective coverage in a variety of situations and conditions. The dispersers vary from small hand-held units to aircraft-mounted spray tanks. Generally, dispersers are employed when a larger amount of agent or a greater area coverage is required. Care must be taken by the operators that intolerable concentrations of RCAs are not released since the larger dispersers can release large amounts in a very short time. The dispersers are designed to disseminate RCAs by aerosolizing them. However, dispersion of liquid RCAs increases operational flexibility since solutions can be disseminated with more

control to a target area than powdered aerosol clouds. Aerosol clouds are more affected by wind conditions than liquids.

M32

The M32 disperser (Figure B-10) is a hand-held pressurized can capable of dispensing CSX solution. The M32 was designed to apprehend, control, or subdue unruly persons, trespassers, and rioters by spraying them with CSX. The M32 disperser consists of an aluminum cylindrical container (6.4-inch length by 1.5-inch diameter) filled with approximately 60 grams (2 ounces) of CSX pressurized with nitrogen gas. The CSX solution is discharged as a jet stream through the nozzle by the trigger on top of the disperser. When the pressure on the trigger is released, the valve closes and the jet stream is shut off. The range of the jet stream is 10 to 12 feet. It will operate continuously for 14 to 20 seconds or approximately 20 to 25 times in short, one-second bursts.

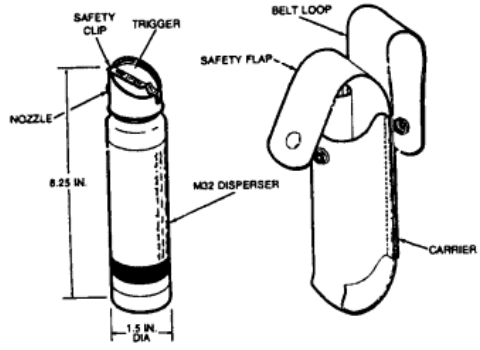

Figure B-10. Disperser and riot control agent, manually carried CSX, M32.

M36

The M36 disperser (Figure B-11), NSN 1365-00-283-9046, is quite similar to the M32 in that it also is a hand-held, pressurized container dispensing the RCA solution, CR (0.1 percent solution in propylene glycol and water). It was designed to apprehend, control, or subdue unruly persons, trespassers, and rioters. The M36 disperser is an aluminum cylinder (6.0-inch length by 1.5-inch diameter) containing approximately 68 grams of CR solution. The cylinder is pressurized with nitrogen gas which causes the CR to discharge through the nozzle in a jet stream upon pressing the actuator. It has a range of 10 to 12 feet. Maintaining finger pressure on the acutator, the operator can dispense the CR solution in a continuous stream lasting 14 to 24 seconds. The operator can also apply 15 to 25 bursts lasting about 1 second each. The M32 and M36 have limited tactical uses,

primarily in enemy prisoners of war (EPW) control, specialized defensive roles and special operating forces when casualties are not desired.

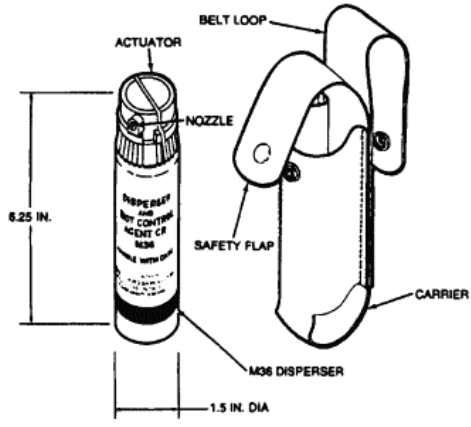

Figure B-11. Disperser and riot control agent CR, manually carried, M36.

Both the M32 and M36 are small enough to be carried and operated with one hand. To use these dispersers effectively, the soldier holds the can upright, aims at the target person's face, and presses the actuator or trigger in 1 second bursts. The bursts are more effective than the continuous spray since the operator can adjust aim with a minimum of RCA waste.

M33/M33A1

The M33 and M33A1 (Figure B-12), NSN (M33A1) 1040-00-148-9824, are lightweight, RCA dispersers that disseminate pressurized riot control agents. The M33A1 looks and functions like the M33. The difference is in the units' capabilities. The M33A1 disperser's modular design allows quick replacement of empty agent and pressure containers. The M33A1 can disperse CS1 or CR solution; however, the M33 cannot disperse solutions. The M33A1 is replacing the M33 on a one-for-one basis as the M33s wear out.

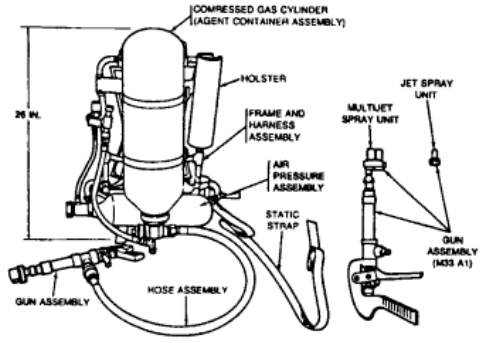

Figure B-12. Disperser, riot control agent, portable, M33 and M33A1.

The dispersers consists of a frame and harness assembly, an agent container assembly, and a gun and hose assembly. The disperser weights 22 pounds empty. A long check valve assembly and multijet spray unit are issued with the M33A1 disperser for spraying solutions. The M33 does not have these items. A short check valve assembly, an agent agitator, and a single jet spray are used to disperse powders. An extra agent container and compressed gas cylinder are provided to disperse two agent fills per mission. The compressed gas cylinder of the air pressure assembly is pressurized with compressed air. The operator opens a valve on the air pressure assembly and pulls the trigger on the gun assembly. Pressurized air from the air pressure assembly forces the RCA from the agent container, through the hose and gun assembly and out the spray unit. The agent container on the M33A1 unit can hold 48 pounds of CR solution, and can fire to a maximum range of 40 feet for a duration of 60 seconds. Both the M33A1 and the M33 agent containers can hold 30 pounds of CS1 and can fire to a maximum range of 40 feet in still air for a duration of 40 seconds. For training purposes, talc can be used in place of CS1. The dissemination characteristics of talc with the M33A1 and M33 are very similar to that of CS1.

The M33 and M33A1 are best used in small unit operations against small area and point targets. They can be very effective in reducing resistance from fortifications, tunnels, and urban complexes. The optimum distance for firing the disperser to produce the greatest effect depends on the wind speed and the operator's freedom of movement across the front of the target area. As wind speed increases, dilution of the powder becomes more rapid. To minimize this effect, the distance between the target area and the operator must be reduced so that an effective concentration can be placed on the target. Close observation must be made of the agent's dispersal pattern and effect on the target.

M3

The M3 disperser (Figure B-13), NSN 1040-00-711-8296, is used to spray CS1 or CS2 from a backpacked container toward or upon targets. The disperser consists of an M2A1 and contains two aluminum agent tanks, a pressure tank and valve assembly, and a carrier section with a frame and harness. The dispersal of agent works in the same manner as the M33 and M33A1 with the agent being forced out of the agent tank through the gun group from the pressurized air tank. The disperser is capable of disseminating approximately 8 pounds of CS1 or CS2 in one continuous burst of 19 seconds, or in intermittent bursts for 30 seconds. The agent is projected about 10 meters (40 feet) before it billows out into a cloud. The M3 weighs 47 pounds empty and 55 pounds when filled with agent.

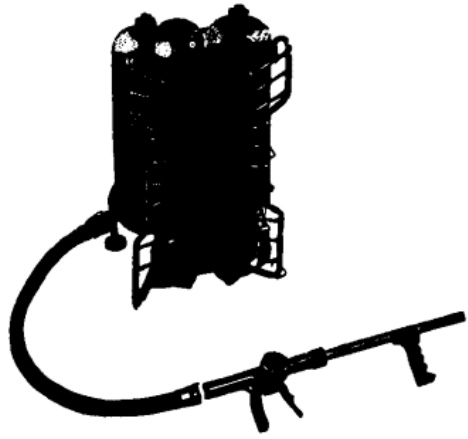

Figure B-13. Disperser, riot control agent, portable M3.

The M3 can be used effectively against small area targets and poorly defined point targets. With an optimum wind speed of 3 to 5 knots, the M3 can cover an area of 2,300 to 3,800 square meters.

M5

The M5 helicopter-or vehicle-mounted RCA disperser (Figure B-14), NSN 1040-00-805-3019, is used to disperse CS1 or CS2 into the atmosphere from either a low-flying cargo helicopter or a moving ground vehicle. The disperser consists of an agent container tank, a pressure group with two air cylinders, a tubular aluminum frame, an M9 gun with a 12-foot hose for vehicle mounting, a 12-foot discharge hose for helicopter mounting, and various controls and instruments. The RCA is dispersed by forcing the powdered agent

from the agent container into the atmosphere through the discharge hose with pressurized air from the air tanks. The agent tank holds approximately 50 pounds of CS1 or CS2 and weights 223 pounds when filled with agent. The M5 disperser has a range of about 12 meters in still air (with gun unit) and 15 to 46 meters from a helicopter at an elevation of 75 to 100 feet. The duration of fire per fill is two minutes with the M9 gun and 20 seconds with the helicopter delivery hose. The M5 is used against area targets and large urban complexes for immediate effects. It can also be used to enhance security by contaminating perimeters.

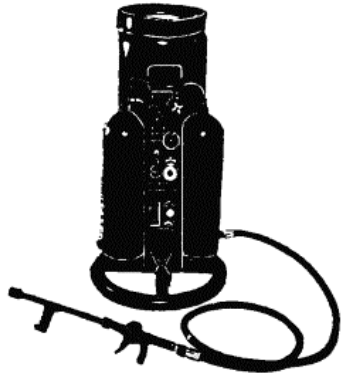

Figure B-14. Disperser, riot control agent, helicopter- or vehicle-mounted, M5.

When a helicopter is used, the agent can be released from either a hovering position above or on the windward side of the target area or along a line above or on the windward side of the target. When mounted on a vehicle and employed against open-area targets, the disperser is operated from positions slightly in front of target areas or formations. Operating dispersers from a helicopter while it is hovering or flying at low speeds may contaminate the helicopter, the crew, and the occupants due to circulation of the agent in the rotor wash. Therefore, the pilot and the copilot should wear a protective mask.

Large concentrations can build up very quickly when the wind is calm and when the target area is partially enclosed by buildings or fortifications. The operator must remember that 1 pound of CS is the equivalent of pound burning-type (M7A3) CS grenades and that 50 pounds of CS can be released in two minutes or less with the M5.

FIELD EXPEDIENTS

The field expedient devices included in this section were developed in Vietnam to compensate for shortages of standard munitions. Any device which provides a container for the RCA and a means of releasing the RCA at the desired time and place will work.

The 1st Infantry Division built the "Big Red 1 Alpha" (BRIA) device consisting of 38 combined grenades as a substitute for canister clusters which were in short supply. Area coverage approximates that of the M 158 cluster cannister. Nineteen M7A3 CS grenades are placed on a precut plywood base. Nylon line (500 pound test) is wrapped twice around the 19 CS grenades. Both wraps of nylon are threaded through an M22 cutter power-activated (10-second delay). After a square knot has been tied and the two loose ends tied into three half-hitch knots, a piece of wood is placed between the two wraps of nylon line and twisted to tighten the line around the CS grenades. The grenade safety pins are then pulled. After completion of two modules, a sandwich is made by placing (in this order): one board, one CS module, one board, one CS module, and one board. A ripcord is fastened to the two reefing line cutters on the side of the BRIA and connected to a D-ring on the floor of a helicopter. To activate the BRIA, pull the three safety pins, activate the cutter on top of the BRIA, wait two to four seconds, and then push the munition out of the helicopter. Optimum release height for the BRIA is about 1,900 feet AGL.

A "Box Full of Grenades" (BFOG) was developed by the 4th Infantry Division along similar lines with 25 M7A3 grenades in a plywood box that was also dropped by helicopter. It was also developed to supplement the short supply of canister cluster munitions.

In other efforts, can bombs were made by cutting bulk CS cans in half and taping them back together. The cans were dropped from helicopters and the tape would split on impact, resulting a crude but effective dissemination of CS.

The bunker use restriction bomb (BURB) was a field expedient device developed in Vietnam to meet a requirement for a small munition which could be carried by foot soldiers and used to contaminate a bunker complex with CS2. The original BURB consisted of a shipping container from a 2.75-inch rocket warhead filled with approximately 1 pound of CS2 and fitted with a timed-delay nonelectric blasting cap detonator. This BURB was deemed too bulky for the troops. Another BURB was made using the layers of the free-fall water bag (an 8-layer plastic bag used to drop water from helicopters). Half of a one-layer bag was filled with 1 pound of CS2. This method proved unsatisfactory because of difficulties in filling and knotting the bags. A request made for a CS2-filled munition resulted in the development of an aluminum foil cloth-type bag sealed in the middle, Some users in the field cut the BURB in half along the heat sealed portion and used the half BURB. About 2,300 ready-made BURBs were shipped to Vietnam.

APPENDIX C

Safety

FIRE AND BURN SAFETY

Unlike raw gasoline, thickened flame fuel is not extremely volatile. However, the residual burning time of thickened fuel is greatly increased when the fuel gels. Thickened fuel will stick to an object and continue to burn. Soldiers must understand the existing dangers of FFE fuel and react quickly to extinguish fires on clothing, skin, or equipment. You cannot stamp out globs or puddles of burning fuel with a boot. You must extinguish these fires by covering them with dirt or sand, or by discharging a CO_2 fire extinguisher at the base of the flame.

Personnel

If burning fuel splashes on a person, he or she must immediately fall to the ground and attempt to smother the flame. Prevent oxygen from feeding the flame by smothering it. When fuel is burning both on the front and back sides of a person, alternately smother the flames on both sides. Done quickly, only minimal injury may occur. Panicking and running can only result in extensive and severe burns. Soldiers not affected by the flame must react quickly to help their buddies in this life-threatening situation. During training, keep canvas, containers of sand, and CO_2 fire extinguishers readily available. Under combat conditions, use battledress uniform or shelter halves to smother the flame.

Equipment

Use standard Army CO_2 fire extinguishers to put out FFE fires on equipment. Expedient methods include the use of water, sand, dirt, and other nonflammable dry substances.

EXPLOSIVES SAFETY

The safe handling, transport, and storage of explosive items must conform to AR 385-63, *Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat,* and those local regulations governing individual installations.

Personnel handling or employing explosives, blasting caps, or demolitions must strictly follow safety rules. They also must follow post regulations and local unit SOPs.

Blast Effects

Generally, the greatest danger to personnel is from missiles thrown by the explosion. Personnel with minimum protection generally will not be in danger from blast effects. For further information refer to AR 385-63.

Missile Hazards

Explosives can propel lethal missiles great distances. The distance an explosion-propelled missile travels in the air depends primarily on the relationship between its weight, shape, density, initial angle of projection, and initial speed. Under normal conditions the missile hazard from steel cutting charges extends a greater distance than the hazard from cratering, quarrying, or surface charges of bare explosives.

CONTENTS

Fire and Burn Safety

Explosives Safety

Safe Distances

Table C-1 gives distances at which personnel in the open are relatively safe from missiles created by bare charges placed in or on the ground, regardless of type or condition of the soil (see AR 385-63 and FM 5-250).

Table C-1. Minimum Safe Distances

Pounds of Explosives	Minumum Safe Distance in Meters
1–27	300
30	311
35	327
40	342
45	356
50	369

APPENDIX D

Herbicide
Spray Systems

NSN	Description
3740-01-157-4000	Sprayer and Duster, Back Pack, Gasoline Engine Driven. Dispenses dust or emulsions and can disperse granules and ultra low-volume (ULV) mists with separate accessories misting nozzle: 3740-01-156-9999)
3740-00-641-4719	Sprayer, Insecticide, Manually Carried, Pressure Type. Two gallon sprayer includes tank, hose, gun valve and wand, 4 separate nozzles, and carrying strap.
3740-00-613-6290	Sprayer, Insecticide, Manually Carried, Pressure Type. Two gallon sprayer includes tank, hose, gun valve unit, and adjustable nozzle tip assembly.
3740-00-375-9154	LECO model HD, weight, 525 lbs.
3740-01-076-1341	Londonaire model XKA weight, 280 lbs.
3740-01-083-3570	Microgen model G-9HD weight, 320 lbs.
3740-01-141-2557	Fog Generator, Insecticide (ULV), skid mounted, gasoline engine driven. Medium duty model used by USA. Leco model MD weight, 238 lbs.
3740-01-206-9635	Fog Generator, Insecticide (ULV), Battery operated. BEECOMIST model 200-251A. Can be powered with vehicle battery or separate 12-volt battery, weight 45 lbs. Lightweight medium duty model used by SN. (Container 3740-00-758-2418)

GLOSSARY

A

absorption--
the process of taking up or soaking up, for example, a sponge taking up water; taking or receiving through molecular or chemical action or change

actuator handle--
the handle of a blasting machine that must be turned or depressed to activate the blasting machine

AFPMB--Armed Forces Pest Management Board

AGL--above ground level

aging period--
the time required for newly mixed flame fuel to change from an applesauce appearance to a smooth syrupy gel

agitate--
to rapidly stir or briskly move flame fuel to and fro during the mixing process

ammunition lot--
a supply of one specific type of ammunition manufactured under the same specifications

AR--Army regulation

ASP--ammunition supply point

ampere--
a measure of electrical current

B

BFOG--"box full of grenades"

blast site--
a particular location designated for the detonation of an explosive charge

blasting cap--
a small tubular device containing explosive mixtures used to detonate an explosive charge

binding post--
spring-loaded receptacle on a blasting machine designed to secure firing wires

BRIA--"Big Red 1 Alpha"

brisance--
the shattering power of high explosives
branch line--
a length of detonating cord that is joined to another length of detonating cord
bubbling--
the mechanical mixing of flame fuel using a source of compressed air to agitate the fuel

C

CINC--Commander-in-Chief

canalizing--
to drive an enemy force into a preplanned kill zone
circuit--
the complete path of an electrical current, shared equally by two or more electrical blasting caps
contact device--
an exploding device that can be initiated through the use of trip wire
continuity check--
the test of an electrical firing circuit
crimp--
to join a nonelectric blasting cap with time fuse by crushing the base of the cap around the fuse with an M2 cap crimper

D

DA--Department of the Army

debris--
solid objects blown into the air as a result of an explosion
decanting--
method of separating water from MOGAS before mixing flame fuel

DODAC--Department of Defense Ammunition Code

DODIC--Department of Defense Identification Code

dual priming--
method of preparing an explosive charge for detonation using more than one blasting cap

E

EO--Executive Order

EPA--Environmental Protection Agency

EPW--enemy prisoners of war

F

F--Fahrenheit

FFE--flame field expedient

firing system--
electrical or nonelectrical method of priming an explosive charge with blasting caps

FLOT--forward line of own troops

FM--field manual

fougasse--
a land mine in which the charge is overlaid by stones or other missiles so placed as to be hurled in the desired direction An exploding directional FFE

fragmentation--
the shattering of a metal FFE container upon detonation

G

gage--
a measurement of the thickness of the steel used in the manufacture of 55-gallon drums

girth-hitch--
a double half-hitch with an additional turn

gpm--gallons per minute

H

hasty emplacement--
a flame device (exploding or illuminating), constructed quickly with available items, and designed to hinder enemy offensive operations

hasty whip--
as shown in FM 5-250, an alternate method for priming a block of explosive with detonating cord

hp--horsepower

I

illuminator--
an expedient flame device used to provide light on the battlefield
impulse--
a sudden involuntarily action
induce current--
to produce an electrical charge in a neighboring charge without having physical contact with that charge
ingenuity--
cleverness or skillfulness
insoluble--
cannot be dissolved

IPSS--Improved Pesticide Spray System

L

lead wire--
wire from an electrical blasting cap
leap frog--
method of connecting blasting caps to detonate several explosive charges

LIC--low-intensity conflict

LDS--lightweight decontamination system

M

main-line--
a single line of detonating cord to which other branch lines of detonating cord are connected

MEA--monoethanolamine

misfire--
a primed explosive charge that fails to detonate

MOGAS--motor gasoline

MOUT--military operations on urban terrain

MRE--meals, ready-to-eat

MSD--minimum safe distance urban terrain

mylar film--
a durable wrapping material that covers composition C4 explosives

N

napalm--
a highly flammable jellylike substance used as flame fuel

NBC--nuclear, biological, and/or chemical

NEO --Noncombatants Evacuation Operations

NSN--national stock number

P

PDDA--power-driven decontaminating apparatus

PDU--pesticide dispersal unit

PETN--
explosive component contained in detonating cord

ppm--parts per million

prime--
to prepare an explosive charge for detonation

priming adapter--
a small plastic device used to combine blasting caps and explosives

propellant charge container--
an artillery powder charge container

psi--pounds per square inch

pusher plate--
a wooden object used to propel FFE fuel from a directional FFE

psychological impact (of FFE)--
the human fear of fire

R

RCA--riot control agents

RDX--
commonly called cyclonite, a highly sensitive explosive and one of the most powerful military explosives It is used alone as the base charge in military

blasting caps Its principal use is in composite explosives such as composition A, B, and C explosives

residual--
fires that remain after the detonation of an exploding FFE

resistance--
the opposition offered by a substance to the passage through it of a steady electric current

RF--radio frequency

ring main--
a ring of detonating cord to which branch lines are connected to ensure a positive detonation

rule-of-thumb--
field formula used in the mixing of flame fuel

RVN--Republic of Vietnam

S

screw picket--
a metal stake used to secure concertina wire

shard--
a sharp, twisted piece of metal resulting from the detonation of an FFE device having a metal container

shipping plug--
a small plastic plug that protects the time fuze receptacle in an M60 fuze igniter

shunt--
the twisting together of electrical firing wires to close a circuit

siphoning--
the removal of water from MOGAS before mixing flame fuel

site--
to locate or place an FFE device to support a combat operation

SOP--standing operating procedure

split colle--
the small cone shaped holder in an M60 fuze igniter that grips and holds time fuze

spoon handle--
the handle of an M49 trip flare

static electricity--
the electricity contained or produced by charged bodies such as that found in atmospheric disturbances

T

tamping--
packing mud around a charge to keep the explosive force confined

TEA--
triethylaluminum, a thickened pyrophoric agent used in the M74 rocket A substance similar to white phosphorus (WP) because it burns spontaneously when exposed to air

thickened fuel--
a syrupy, sticky liquid composed of MOGAS and M4 thickening compound used in FFE devices

TM--technical manual

TNT--trinitrotoluene

TOF--trioctyl phosphate

U

unthickened fuel--
a 60:40 mixture of MOGAS and oil used in FFE devices

V

V-trench--
a shallow trench in the ground the size of a 55-gallon drum dug at an angle with the back deeper than the front

volatility--
rapid evaporation of a flammable liquid, changing into vapor, as in FFE fuel

W

WP--white phosphorus

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Documents Needed

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Readings Recommended

These readings contain relevant supplemental information.

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